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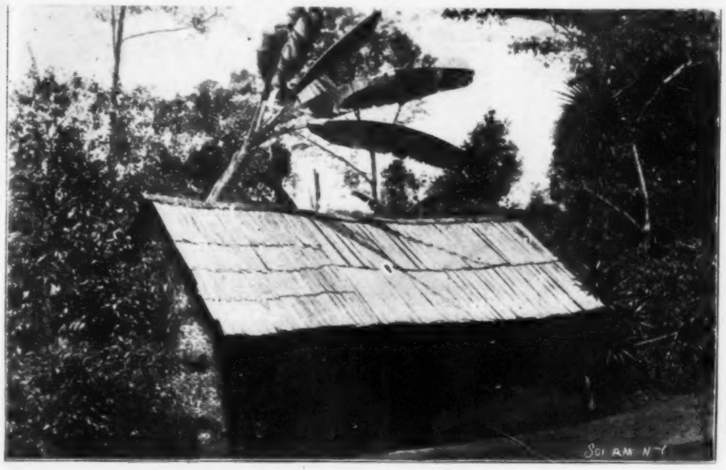


NATIVE HUT BY THE WAYSIDE, CORDOVA.

NATIVE HUT NEAR CITY OF MEXICO.

BABEL WATER TOWER.

COLOSSAL HEAD OF SERPENT.

AZTEC MONUMENTS, CITY OF MEXICO, NATIONAL MUSEUM.

TYPICAL MEXICAN HACIENDA.

CATHEDRAL, CITY OF MEXICO.

HUITZILOPOSTLE, AZTEC GOD OF WAR.

MEETING OF THE PAN-AMERICAN CONGRESS IN THE CITY OF MEXICO.

MEXICO.—I.*

Mexico is filled with ruins indicating in their architecture the highest state of former civilization and showing, in many instances, a thought for sanitation and the necessities of life equal to that of the present day. When first known to Spain, over thirty tribes of Indians could be counted wthin her boundaries. Some of these are now practically extinct. Before 1524 A. D. her population exceeded 30,000,000—now diminished to 13,000,000.

Mexico's railroads afford the following statistics: total mileage April 1, 1897, 7,429 miles; passengers carried in 1876, 4,281,327, and in 1895, 24,269,895; freight handled in 1876, 132,915 tons, and in 1895, 4,117,511 tons; gross receipts of railroads in 1876, $2,564,870, and in 1895, $28,758,450. On April 1, 1897, Mexico's telegraph lines aggregated 28,123 miles.

GENERAL CHARACTERISTICS.

Her east coast line since Yucatan's inclusion in her territory extends over 1,700 miles along the Gulf of Mexico and Caribbean Sea and bears several very important cities—Vera Cruz (its main port) being the lower one; while at Tampico, a little further north, immense improvements have recently been made, docks are being built and it is probably destined to be the most important shipping port of Mexico. The western coast line (embracing Lower California) stretches over 4,500 miles upon the Pacific Ocean and Gulf of California. What is now Lower California, Arizona, Texas, and a half-dozen other states of our Union formerly belonged to Mexico, and through two or three different negotiations was ceded to the United States.

Northern Mexico is nearly all arid and dry—consisting largely of alkali plains with only here and there a fertile valley, where courses of water run down from the mountain sides, generally rugged and indicating volcanic formation.

The climate embraces almost every variety. On Popocatapetl, 17,540 feet high, one can descend to the very heart of the tropics and ascend to the limit of perpetual snow. From the city of Mexico a half-dozen mountains, always snow-capped, stare you in the face from every direction. Humboldt characterized the flora of Mexico as one of the richest in the world; as, by traveling a few miles, one experiences the whole range of Arctic, temperate, sub-tropical and tropical conditions.

Mexico's population of about 13,000,000 is wonderfully mixed—about 11,000,000 being the descendants of over thirty different tribes of Indians; the mixed Spaniards and other immigrants constituting the remainder.

All through the towns are water-carriers. They have fountains placed at various convenient points; the water is not piped into the houses as with us; but the water-carriers go about from house to house, delivering the fluid for the day's use—to some houses several times a day, charged accordingly. In some places the water is carried on the shoulders in large earthen jugs and pitchers of domestic make; in other places, on small burros—the jugs resting in frames on each side of the animal. Many a Mexican meat-market travels on foot, horses being saddled with quarters of beeves, which are thus hawked about the street.

Leaving the railway, in some parts of Mexico—the country being extremely rough—almost the only means of transportation are the burros. Sometimes there are carts, but generally the road is too rough for that; and manufacturers in the United States seeking Mexican trade must understand that if they are sending their goods for transshipment to small towns they must be packed in waterproof packages weighing not over 150 pounds, so as to be balanced on each side of a burro—transportation right through the country to destination often taking from one to five days, subject in the wet season (during certain parts of the year) to heavy rains.

CITY OF MEXICO.

The city of Mexico is one of the strangest imaginable. The inhabitants pass from the most civilized to the absolute Indian only partially clothed and living in his hut just outside of the better streets upon a hide on the ground, without the slightest furniture or any of the ordinary conveniences of life—doing his cooking, perhaps, in one or two earthen vessels on a pile of coals between two stones. A tour of the city finds all these habits and customs exemplified in the markets for the populace: the strangest dishes are there cooked and prepared for the common people, who thither bring their fruits and wares for sale. From vermin and the condition of the inhabitants there is fearsome passage through these commoner markets; while one must be fairly careful traversing some in the better quarter.

Then comes an entire change to one of the flower markets of the city of Mexico. Near the central plaza at one part are assembled every morning some hundreds of people from without the city, with bunches of flowers to sell—beautiful orchids, most exquisite lilies, and all other varieties.

From St. Louis, entering the northern part of Mexico at Laredo, the elevation is only a few hundred feet above the sea; but gradually ascending through nearly a thousand miles to the city of Mexico you are on an extended plateau over 7,000 feet high; and while in the tropics, surrounded by palms and an ideal tropical environment, you are yet in an evening temperature demanding wraps and a light overcoat—caused, of course, by the great elevation, which is quite inconvenient and uncomfortable for sensitive people.

The city of Mexico is said to be several feet lower than the surrounding lake region, which has been drained, but the entire vicinity was at one time in all probability one continuous lake. The lakes are very shallow and confined to certain areas northwest of the city; and it is one of the great problems to drain it in its depressed situation. The lack of systematic drainage makes it the most unhealthy city in the world. Immense operations are in progress to lay the proper sewerage, drain the whole city and dispose of the sewage entirely by the dry method.

The water for the city of Mexico is taken from the higher mountain ranges and conducted by gravity in pipes. Many of the cities of Mexico thus instituted their water systems almost in prehistoric times—their aqueducts (thrown across the valleys) being even higher and larger than the great Roman structures conveying the supply to the Eternal City.

Running through one part of the city and extending out into the country some little distance is the Viga Canal, whereon is brought the marketing from one section of Mexico. At certain times in the morning the little skiffs, scows and boats of all descriptions are ranged together so closely as greatly to impede navigation.

FORESTS.

The largest and finest trees in Mexico are exotic—the eucalyptus, introduced from Australia, being the most magnificent. It skirts some of the very finest of the broad streets extending toward the President's palace, called Chapultepec, two or three miles out from the city and situated on a hill—the trees around and near it being of the famous old cypress variety, with, in front, one of those ancient aqueducts brought into the city from a long distance, and probably 25 feet high, arched, with the running water carried above. In early times it was able to bring water easily into the city, but has not within recent times been used.

The immense cypress trees, which have a diameter of something like forty feet, are interesting. Though not so tall as many of the California trees, they exceed all trees in diameter. The history of the cypress is very interesting: it only occurs in wet places. Some species are seen on the James River, where they grow out in tidewater—the roots projecting above the surface of the water and acting as breathing organs for the tree. It never grows outside of water except where planted by hand.

PUBLIC SAFETY.

As to the President of the Republic of Mexico, I believe that Diaz is the sharpest, most acute and wisest statesman on the American continent. He began his reign, so to speak, a great many years ago, when it was absolutely unsafe for a man to travel anywhere in Mexico. If he went to any point whatsoever, he must go with an escort of soldiers; insurrections, robbery and murder were every-day occurrences in almost all parts of Mexico. The population was an extremely peculiar one—the remnants of so many Indian tribes, all speaking different languages, all having different habits and customs—presided over and ruled by Spaniards in some parts of Mexico and in other parts by Indian chiefs; a greater mixture and a more peculiar set of people could not be conceived of. President Diaz began his rule with great firmness, accompanied by his bodyguard and guards in general, making arrests everywhere where there was any misrule, himself; sometimes, where the misrule was pretty sure and the crime was very sure, not stopping for any lengthy trial, but shooting the offenders; because, in the beginning, it was a matter of compelling recognition of his power, and he was liable at any time himself to be overcome, as dozens, almost, of rulers before him had been. He has reduced this class of people to the most orderly in North America, and they are absolutely subservient to the good government which he has established. He has in this way made Mexico the safest country in North America to travel in—a country whose entire length you can traverse without danger of robbery or molestation. He has done this with an iron hand at first; but, as he could, he has tempered that severity until I believe, to-day, he is the most respected and the most loved person in Mexico.

EDUCATION.

At first there were all kinds of insurrections against him by the different rulers. He brought them to order; he inaugurated a system of education, first for the army itself, by selecting orphans and persons who would have no particular family traditions and who would not look back to former jealousies and hatreds that had been caused by insurrections and shootings. He selected friendless boys and brought them into the city, and with the public money educated them, brought them up, and put them in the army, until to-day nineteen-twentieths of the army officers are men who owe their whole career and education—everything—to him. Of course, they are true to him; and it would be next to an impossibility to organize at the present moment the slightest insurrection or opposition to his will.

His course has been a wise one in stimulating commerce in every way possible; he has inaugurated systems of education until there are schools established by the government covering almost every phase. So long ago as May 25, 1888, he secured the passage of a law making education compulsory, believing that the education of the Mexican people is the salvation of the nation. He has inaugurated means of bringing his country into closer commercial relation with the United States, deeming that government in every way the natural ally of Mexico; he has made the study of the English language in the schools compulsory, because of the proximity of Mexico to the United States and the belief that that was the way to induce closer relations, not only in amity, but in trade. He has established national schools for engineers, horticulture and veterinary surgery; a high school for commerce and international laws; a national school for trade and art for men; a practical school for mechanics such as those in England; for industrial art, such as ours in Philadelphia; a national school of arts and trades for women. He distinctly believes in the education of women: he has established several normal schools for their education as teachers. In a conversation with him a few years ago he expressed the thought that one of the potent means of educating the Mexican people lay in the education of the mothers—that they were the natural teachers. In carrying out that thought he has established several normal schools for women (as well as this national school of art and trades), to teach women how to be self-supporting. He has established the Correctional School of Trades and Professions; that is, a school for such boys and girls as have proved slightly unruly; he has some taken care of, not in a house of correction exactly, but a much milder form than that, where he has put them into educational work; he has established a national school of fine arts, also a medical school; a national conservatory of music; a military college (which was one of the first institutions he organized). He has also established and endowed a national school for the blind; a school for deaf mutes; an industrial school for orphan boys; a school, also, for jurisprudence and several schools (also coeducational) for training teachers.

PUBLIC IMPROVEMENTS.

Among the characteristic incidents of the President's career, one occurred some time ago, when the railroads were first built through Mexico. The ordinary Indians (and there are 11,000,000 of them) opposed, at every turn, the progress of building these railroads—doing everything they could against them. It was, as the North American Indians believed, an uprooting and an overturning of their customs and their former life, which they opposed wherever they could; these railroads had to be guarded; and if you ride over one of them now you will find that there is a national guard with his gun and other arms (and sometimes two guards) at every station. This guard was absolutely necessary ten or fifteen years ago; and the law has not been done away with. An incident is recalled where some years ago a train was fired upon from the bushes. Mexico is divided up into States; the States into smaller divisions; and this was near a town where lived the governor of a State. President Diaz notified the governor that he would like to have these culprits sent up to him to the city of Mexico. It was his usual practice to get hold of these whenever they perpetrated any such misbehavior and shoot them; and he sent to the governor and asked him to send them up. Sometimes these governors, being natives and native Indians, sympathized a little with whatever went on against the general government; and after eight or ten days, hearing nothing about it, he sent down to the governor again and got the answer that he was trying to find them but had not succeeded. He then sent word to the governor that he would give him just ten days to find them, and if he did not find them in that time he would send for him and the governor would suffer the penalty himself. They were found in a day or two and sent to the city of Mexico and shot. That was the way all offenders of that kind were dealt with at that time.

INSURRECTIONS.

Another instance: in the first ten or twelve years of the government carried on by President Diaz, there were numerous insurrections; and some of the older men, as President Diaz owned, were very much opposed to his government and had been in the habit of stimulating rebellions. Some of these still live. A few years ago one of them, gray-haired and old, off in a remote western part of Mexico, stimulated an insurrection. It was close to a great fête day. The President sent for him, caught and brought him to the city of Mexico. He was an old and dignified man who had been misguided and had fallen into this course. Everyone expected that he would be shot on the next morning; but the President (of course perfectly secure in his course) kept him confined until the day of the fête (which was a national one) arrived; brought him out and put him at the head of one of the regiments and told him to command the regiment for the day. Everyone was surprised to see this old man, who had offended and whom they had expected to see shot, leading one of the regiments; but he was forced to do it. After the day had passed the President simply dismissed him and told him to go to his own home and sin no more—to be careful that he fall not in such ways again; and the old general felt (since he was escaping with his life) most grateful—that in the natural course of things he should, or would, have been shot; and returning home, this last sign of an insurrection in Mexico disappeared.

President Diaz has projected several trips to the United States—one, particularly, in 1898—but for some reason abandoned it, after having built a very handsome car in which to tour the country. It is to be hoped that we shall at some time in the future see him here.

RELIGION.

As to the state of religion as an institution in Mexico, the first Constitution established the Roman Catholic religion in 1824, excluding all others; but by the law of July 12, 1859, religious liberty was proclaimed; the Church was separated from the State; and every one could, and can, worship according to the dictates of conscience.

ARCHAEOLOGICAL REMAINS.

The ruins of Mitla have the general character of all prehistoric ruins in Mexico—the outside walls showing the carving and architecture with great columns built out of volcanic rocks; the interior (from which have been taken pieces of statuary and all kinds of material), the wonderful civilization in household art attained by its prehistoric creators.

COFFEE.

Four to five million dollars' worth of coffee is annually exported from Mexico, and is one of the most profitable products. The coffee tree (usually grown under the shade of other trees) as a rule begins to bear when it is only three or four feet high and five or six years old, and may produce two or three pounds when it is only seven or eight feet high. It has a pretty white flower, sweet-scented; and passing through the coffee plantations in full bloom the odor is very pleasant. Coffee has to be sorted and picked. One of the very delightful things is, you can get every grade of coffee—the finest Mocha, the finest Java, the Malay berry and the Rio berry—all off the same tree: in other words, the size, character and shape of the berry makes the Mocha; a little difference in the oil gives you the Java in certain places; and the berries in some cases produce only one seed, and then it is round and called Malay berry; and the differentiating is all in the picking of it. One of the floors of an Indian's hut is covered with coffee; it is constantly shoveled over from one row to another, drying the berry, which is red, with two seeds covered with a sixteenth to an eighteenth of an inch of pulp; and they are picked and thrown on these clay floors and shoveled over and over until perfectly dry.

(To be continued.)

* Abstract of a lecture delivered at the Temple College, Philadelphia, by Dr. W. P. Wilson, Director of the Philadelphia Commercial Museums, and by him specially revised for the SCIENTIFIC AMERICAN SUPPLEMENT.

LESSONS FROM THE AUTOMOBILE ENDURANCE CONTEST.

By Prof. R. H. THURSTON, in the Automobile Review.*

A study of the returns and tabulated data of the automobile contest of last month reveals nothing which was not previously tolerably well understood by experienced automobilists and engineers, but it does give a better and more reliable set of data than has ever before been secured, in this country at least.

The "race"—which could hardly be called a race, however—began as per programme, at New York, and terminated at Rochester, a distance of 395 miles. The roads were rough, uncared for, and muddy in many places, and the weather was often exceedingly trying. Under these circumstances half of the vehicles starting, 41 out of 80, reached the goal, and many of these, at the official termination of the "race," went on to its originally proposed terminus, at Buffalo. The actual official time was five days; the time to Buffalo was six days. The distanced vehicles were thrown out by the various accidents incidental to highway travel, and to which all travelers and their carriages are at times liable. The fact of being thus thrown out by accident does not necessarily reflect upon the design, construction or system of operation of the carriage and, in some cases, not even upon the management at the time; although carelessness and errors were presumably responsible for some misfortunes, and such faults are not to be attributed to the machine or its builder. The trial was a real trial, in every sense, and the credit is all the greater for those machines, and their skillful drivers, reaching the goal in good order.

At a glance, it is seen that the motor-bicycles, as a class, are a failure in such work as that to which they were put on this occasion; but the defect is not, probably, mechanical so much as physical, and that of the rider rather than of the machine. The bicycle, motored or other, is not fitted for successful work on roads hub-deep with mud, and the motor may be here considered as on the whole, an advantage in this class, giving, as it does, immensely increased power to meet the increased resistance. No motorcycle, however, should be expected to contend with difficulties which should be easily surmounted by the other types of vehicles.

These remarks do not apply to the automobile delivery wagon, and it would be expected, ordinarily, that these always powerful machines would force their way wherever the lighter machines could go. There were but two in this class, however, and drawing conclusions from such limited data is somewhat hazardous. Had there been a dozen such machines in the run, it is possible that the other ten might have come through, and it is, perhaps, probable that half of them would have survived. Judgment may be very properly suspended here.

Respecting weights of vehicles, it is interesting to note that of those weighing less than one ton, just about one-half survived, while of those exceeding that weight three-fourths came in at the close. This is, however, simply the natural result of pitting vehicles of varying powers against similar difficulties, and the case is somewhat similar to that of the large and the small steamer crossing the Atlantic in periods of rough weather. The larger feels comparatively little the disturbances which are seriously discomforting to the smaller craft. Among these vehicles, in classes A, B and C, the weights were in the proportions, roughly, with the largest in these classes—1,000, 1,500 and 2,500 pounds.

The power demanded would seem to have been, for successful work, about 10 horse power per ton weight of vehicle; the average of all being not far from that figure, excluding those which failed. There was very little difference, however, in this average for all entering and for the victors. There was, however, a marked difference in the powers reported for the gasoline and the steam automobiles; the figure for the former being 12, and for the latter, about 9 horse power per ton. It is possible that a part of this difference may be due to variations of the reported from the actually exerted average power. It would be interesting could this question be solved, and probably very instructive. It would hardly seem likely that differences in the mechanical efficiency of the two classes of motor and their machinery of transmission should be as great as is indicated by the reports. It is also particularly interesting to note that the speed of the vehicle bears no exact relation to the rated apportionment of power to weight.

Nothing appears in the record to indicate a superiority of one of the principal wheel-constructions over the other, or any special difference in the working of the principal classes of steering gear. Accidents occurred in great variety, but it does not follow that the disabled machines were ill-designed. In many cases they were subjected to strains which would never be expected in ordinary use, and such as their designers never proportioned them to meet and, in other cases, the accident was just as likely to disable a strong as a light construction. No vehicle is designed to go through a collision or into a ditch without injury. The conclusion in this matter is simply that those which actually came through such a hard trial successfully were certainly well-built and probably very fortunate, and that some of those disabled may have been quite as good but cannot be identified by the record. The sharp rivalry of the light White steamer and lighter Pierce gasoline carriage with the heavy Panhard, of 50 per cent greater weight and double the power of the steamer, illustrates the points here made. Heavy and light, light powered and the most powerful succeeded in getting to the end of the journey and about an equal number of each type fell out in the intermediate classes, while the lightest of all, the motorcycle, and the opposite extreme, the delivery wagon, more generally failed.

The pneumatic tire proved itself a vastly more reliable detail than was generally anticipated, and its use is probably assured by this experience in work for which it was formerly thought ill-adapted. Something over 10 per cent of the tires in use at the start were replaced in the course of the journey, but, of these, four, or one-fifth the total number, were replaced as too small and not because of wear alone. Only twelve of the carriages were subject to this annoyance, and only four replaced more than one tire in the run. They did their work well on heavy as well as on light vehicles, and the makers and users are alike entitled to congratulation.

Those makers starting a number of carriages and bringing them all through were few in number, but were correspondingly pleased, as their percentage of efficiency, toward the end of the course, became more and more probably 100. The White steamers were particularly fortunate, the makers having four on the list, all of which came in at the end. This is the more interesting to the automobilist and the mechanical engineer, as those novel constructions embodied some very original devices, the value of which could only be certainly determined by some such severe test. The steam and fuel regulating, or rather self-adjusting, system was a particularly uncertain element in the minds of those unfamiliar with their use, and the water-tube boiler, with its singular construction, was looked upon by many very much as was originally that of Serpollet, ten or a dozen years ago, when it was brought out in Paris. This test will probably go far to settle any question regarding that construction.

The three-wheelers both came through well. The gasoline machines generally had little special trouble with their machinery, and none is reported from any of the carriages in the handling of their stores of explosive fluid. The ignition, as always, gave most trouble, and it is evident that there is still opportunity for improvements that shall make the spark certain of production and sure in ignition. The motor mechanism and the carburetting devices now seem to give comparatively little trouble in the older machines and where the long-tested forms are employed. Little improvement need be expected in these directions, probably, and little seems called for.

The distanced steam carriages usually failed through the defects inherent in any machine composed of a multiplicity of parts, and the lesson here taught is the necessity of reducing complication to a minimum and then of making every smallest detail so carefully that it can be individually relied upon for good work through a long life and under occasional excessive taxation. Lubrication requires perfecting, and some system that shall insure free oiling of every, even the most insignificant, journal and rubbing part, without waste or risk of an instant's cessation, must distinguish every ultimately satisfactory motor, and its vehicle as well. A circulating system seems the most promising arrangement, and this certainly ought not to prove impracticable on any automobile, although the difficulties are likely to prove less easily surmounted on the steamer than on the gas engines, where, in fact, they are comparatively unimportant.

Both classes show, in this trial, as in their daily operation, the necessity of feeling out carefully the proper distribution of weight, and particularly of strength, in running parts and the practically best factor of safety for every detail. It will undoubtedly be discovered that, where four or five may answer for one part, eight or ten and sometimes twenty is none too high a factor for another; the one carrying a practically static load, the other subject to sharp blows and heavy shocks.

But while a study of the record is instructive to all who have any special interest in the new system of locomotion and transportation, only those who handled the carriages and the makers to whom the cost of repairs en route come home can judge with accuracy the relative merits of specific constructions. The carriage of which the mechanism was practically rebuilt, and perhaps built over several times, in its less reliable details, even though repeated at the end of the run, owing its success to the talent, perhaps the genius, of a fortunately chosen operator, or a repairer sent along from point to point to meet the machine for the purpose of reconstruction as required, can hardly be pronounced a thorough success, and the records do not show with accuracy this feature of the case. Some of the carriages thrown out might have gone through, probably with glory, had they been provided with the genius needed for their maintenance; while of those reaching the goal, some, very probably, would have remained behind on the banks of the Hudson had the special genius not been at hand, from New York to Rochester or Buffalo. The makers have learned much more than the public.

It is a matter of extreme regret that the electric automobile could not have entered the lists, and the need of a compact and light, yet powerful, storage battery for that class is, by that fact, emphasized. For many places and purposes the electric vehicle is the ideal, and everyone interested in the automobile is looking with anxious eyes for the undoubtedly coming invention. There are already one or two promising advances in sight, and probably many able men are studying the problem of reduction of the storage battery to such size and weight per unit of power as will give us an approximation to the ideal case. Weights, per horse power hour, should be reduced to a fraction of those usual to-day. They undoubtedly will be greatly lessened soon. With a satisfactory accumulator, such a route as that selected for this latest test could be readily traversed; every city, and even here and there a country village, will provide current for them once they are established as a practicable means of transportation over long distances and on rough roads.

These tests should be continued and the lessons studied, and also of that just concluded at D'Eauville, in which Serpollet made such a sensation with his little steamer and water-tube boiler, and of that which is about to be undertaken by the British army officials, for heavy wagons and traction engines, will rapidly lead to the development, permanently and satisfactorily, of automobile vehicles of every class.

In future trials, short or long, for speed or for endurance, it is to be hoped that it may be found practicable to settle many still uncertain questions; as the minimum weight consistent with durability of each class of automobile for specific sorts of work; the costs of operation, not only in fuel and lubricant, but also in maintenance and repair; the relative merits of water-tube and fire-tube boilers for steamers and of thermodynamic systems for gasoline motors; the availability of the various automatic devices for continuous and practical work; the economy of superheating steam for the steam motor, and the possibility of securing a thoroughly satisfactory system of ignition for all standard forms of internal combustion engine. Perhaps no less important than either of these questions is the practicability of introducing the electric motor into long-distance work and for economical business transportation. At least two accumulators are announced as presently likely to assist in solving this last problem, and it is entirely reasonable to assume that the limit of improvement, even where, as promised, their weights are to be reduced one-half, will then be reached. The real limit here, as in substantially all of the work of the engineer, is set by the solution of the financial problem, the attainment of the practicable maximum of commercial efficiency.

* The name of Prof. Thurston of Cornell University, by whom this article was expressly prepared for the Automobile Review, is known throughout the whole scientific world. His expressions therefore will have added weight to the automobile industry, in which he is a thorough believer and takes a keen interest. It gives us unusual pleasure to present some opinions on the test from probably the greatest living authority on the steam engine and the mechanical engineering problems of the day.

THE ABANDONED FARMS OF NEW ENGLAND.

In a few articles in various magazines, as well as through other literature, the public has become generally acquainted with the rural desolation of the hilly regions of New England, says the Street Railway Journal. The stony fields, particularly those of Massachusetts, from which a scanty livelihood was obtained by our predecessors during the first three hundred years of the country's history have gradually been deserted by the descendants of the original proprietors. Possessed sometimes by a desire for city life, and enticed in other cases by the far more fertile prairies of the middle and far West, the younger element gradually drifted away from the life of farming in New England, with its unending toil and scanty returns, and the farm houses which had sheltered three generations were gradually abandoned to solitude. At one time it seemed as if the sturdy farmer stock of New England, which had fought the Revolution and which had been the backbone for so many years of the American nation, would entirely emigrate from their original habitations, leaving their farms deserted or to be occupied in some cases by emigrants who could hardly speak the languages of their predecessors and knew nothing of their traditions.

It cannot be denied, however, that a change has been effected in this tendency toward the disappearance of New England farm life, due partly to the rehabilitation of some of these properties by city residents who have been anxious to possess a domicile in the country for part of the year, and partly by the extension of the city railways into the country districts. Without the latter, the effect of the former factor would have been slight. But the construction of the network of electric railways which now covers the eastern portion of Massachusetts, and which is being extended rapidly all through southern New England, is already exercising a radical change in the conditions of living through that district, and it will undoubtedly arrest, in part if not completely, the depopulation of this region. The effect of the interurban railway is to provide a conveyance much more comfortable, quicker and very much cheaper and more convenient than a private carriage for each of the denizens along the highways and byways over which it passes, by means of which he can transact his business or sell his daily labor or produce in the neighboring village, town or city, retaining at the same time all of the advantages of rural life. The factory hand no longer has to live within fifteen minutes' walk of his shop, nor is the farmer obliged to spend half a day, two or three times a week, in hauling his farm produce over rough country roads to dispose of it in the nearest market. In this way the electric road has and is effecting in the districts in which it has been introduced a revolution in social life and environment, and in adding enormously to the value of the rural property is contributing a generous increment to the morals, health and well-being of the community through which it passes. The same condition of affairs, it is needless to say, is also occurring in other parts of the country, particularly in Ohio, Indiana and eastern and southern Michigan, where the interurban railway activity up to the present has been most pronounced. But as a social factor the interurban railway is making its influence felt in all parts of this land of ours, and will do more so as its sociological advantages become more thoroughly realized.

A WHALE'S "SWEET" PERFUME.

WRITING on "Animal Perfumes and their Origin" in Knowledge, Mr. R. Lydekker makes the following observations regarding ambergris. "Ambergris is generally found floating on the surface of the sea, and very different ideas have been entertained as to its nature and origin. It appears, however, that so early as the middle of the sixteenth century it was known to have some connection with whales; although the nature of this connection was not fully realized. One writer, for instance, in describing a sperm whale stranded on the Norfolk coast, expresses his surprise at not finding ambergris in its stomach. Although the idea that ambergris is swallowed by the sperm whale is erroneous, the writer in question was quite correct in regarding that substance as pertaining to this particular species of cetacean. The fact that it contains the horny beaks of squids and cuttles belonging to species that form the food of the gigantic sperm-whale, or cachalot (by far the largest of the cetaceans furnished with teeth), is alone sufficient to indicate that it is a product of that monster. And from time to time it is actually found in the alimentary canal of that whale. It appears, indeed, to be a biliary concretion, closely analogous in its nature to bezoar stones, and due to the existence of disease in the individuals in which it occurs. In place, therefore, of being found only in old and strong specimens, it is generally at least met with rather in those in poor condition or which have died a natural death. When first taken from the sperm-whale's interior ambergris is a soft greasy substance, exhaling an exceedingly disagreeable odor; and it is only after exposure to the air that it hardens and acquires its characteristic aroma, which is described as being sweet and earthy."

BENZINE MOTOR CYCLE.

ONE is apt to feel that the railway locomotive is a magazine of power, an annihilator of distance, an embodiment of energy and altogether a marvelous production which commands respect almost as if it were a thing possessed of life and intelligence. Recently a locomotive has been devised for the use of the individual, which is no less interesting than the railway locomotive. It combines the peculiarities of the bicycle and the locomotive, and forms a new species of machine known as the motor cycle.

The particular machine which we illustrate was made in Munich, Bavaria. It was used in Germany by Mr. Henry Hirsch, of the SCIENTIFIC AMERICAN corps, and was by him brought to this country. It has been run over the ample floors of this office, much to the interest and amusement of the employés and visitors who chanced to be present at the time.

We have made an elaborate set of illustrations on account of the novelty of the machine, as well as the interest attached to the motor, aside from its connection with the bicycle.

In Fig. 1 the machine is shown in actual use.

Fig. 2 is a side view, partly in section.

Fig. 3 is an enlarged perspective view of a portion of one of the cylinders, showing the valve motion.

Fig. 4 is a sectional view of the benzine reservoir.

Fig. 5 is a view of the igniting apparatus, with parts broken away to show the internal construction.

Fig. 6 is a detail view of one of the ignition tubes.

Fig. 7 shows the valve controller.

The frame of the machine is formed of four parallel tubes, two upon either side, connected with the main journal boxes of the rear or drive wheel, and united at their forward ends with two pairs of oblique tubes connected by cross bars at the top, and carrying the steering head, in which is received the shank of the front fork, as in an ordinary bicycle.

Between the two pairs of horizontal bars are secured two motor cylinders, formed in one casting and provided with a water jacket. The cylinders contain pis-

FIG. 2.—SIDE VIEW OF MOTOR CYCLE, PARTLY IN SECTION.

F[illegible] DETAILS OF GERMAN MOTOR CYCLE USING BENZINE.

tons connected by piston rods with the crank on the main shaft. The bearings of the crank pins, as well as the bearings of the main shaft, are rendered nearly frictionless by the use of balls, as in the bearings of an ordinary bicycle. The cylinders are single acting, and the cranks, which are on the opposite sides of the rear wheel, are parallel, and extend in the same direction. The engines work on the four-cycle principle, and are so timed as to give one effective impulse for each revolution of the drive wheel.

On the top of the cylinder, above the explosion chamber at the rear of the piston, is a valve chest containing two pairs of poppet valves, one pair to each cylinder. The valve chest is furnished with two separate chambers, one for the supply of the explosive mixture, the other for the escape of the exhaust, and

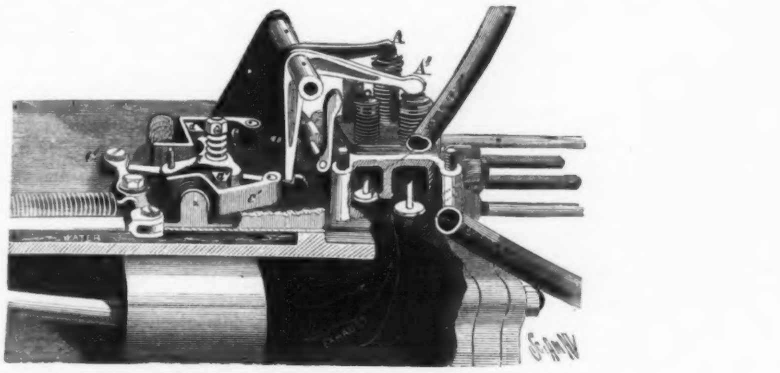


FIG. 3.—VALVE MOTION OF MOTOR CYCLE.

the valves are held to their seats by spiral springs surrounding their stems, as shown. The valves which admit the explosive mixture are provided with light springs, so that when the pistons move forward the valves open inward automatically; but the exhaust valves are furnished with heavier springs, which hold them to their seats at all times except when they are depressed by the valve operating levers, *A*, *A'*.

These levers are made to open their respective valves in alternation by the peculiar combination of levers shown more clearly in Fig. 3. Upon the side of the rear or drive wheel is secured a cam, *B*, upon which presses a roller, *a*, carried by the arm, *b*, jointed to the lower side bar. A rod connected with the arm, *b*, is jointed to one end of the lever, *C*, the opposite end of which carries the hook, *D*. To the hook, *D*, is pivoted a three-armed lever, *E*, which is held in frictional contact with the hook by a strong spiral spring.

Pivoted to the top of the cylinders are two arms, *c*, *c'*, which are pressed toward the center of the cylinder by springs. The forward projecting arm of the lever, *E*, is capable of bearing against the free end of

FIG. 4.—BENZINE RESERVOIR.

one or the other of the arms, *c*, *c'*. The shorter arms of the lever, *E*, are alternately brought into engagement with studs, *d*, *d'*, projecting from the top of the cylinders. The angled arms, *A*, *A'*, are pivoted on a rod supported by ears projecting from the cylinders, and their downwardly projecting ends are engaged in alternation by the hook, *D*. This action of the exhaust mechanism controls the machine.

The ignition of the charge is effected by heating the nickel tubes projecting about 2½ inches from the rear ends of the cylinders into the ignition box. In this box is placed a heating vapor burner, receiving its vapor from the vertical tube at the side of the box, which contains a wick saturated with benzine supplied from the reservoir. The tubes extend into a fire-clay chamber, in which are loosely placed three nickel spirals below the tubes, for distributing and retaining the heat. The heating burner, arranged in this way, effectively heats both nickel tubes, thus insuring prompt and regular explosions. The ignition tube is provided at its inner end with a flange which is clamped in place by a yoke, shown in Fig. 6. The lower oblique tube on one side of the machine conveys air to the burner, and the oblique tube on the other side serves as a chimney for carrying the products of combustion from the burner. These tubes terminate in a comparted hood, *F*.

The benzine is contained in the reservoir, *G*, supported by the oblique tubes at the front of the machine. This reservoir is connected directly by the small pipe, *e*, with the burner which heats the ignition tube. In the top of the reservoir, *G*, is inserted a screw-capped filling tube, *f*, the lower end of which is covered with wire gauze. To the top is attached a screw-capped nipple, *g*, through which extends a wire having on its lower end a cork float, by means of which the depth of the liquid in the reservoir is ascertained.

A conical air supply tube, *h*, projects into the reservoir and is provided at the top with a hood through which air enters into the reservoir. This hood is furnished with a check valve which keeps the tube closed except when a partial vacuum is formed through the action of the engine. The tube, *i*, projects into the reservoir and is provided with a hollow spherical lower end in which is formed a transverse slot. In this tube is inserted a wire or gauze cone connected at the top to the regulating valve, *H*, which latter also communicates with an air supply valve, *k*. The regulating valve, which is thin, is arranged to slide over the

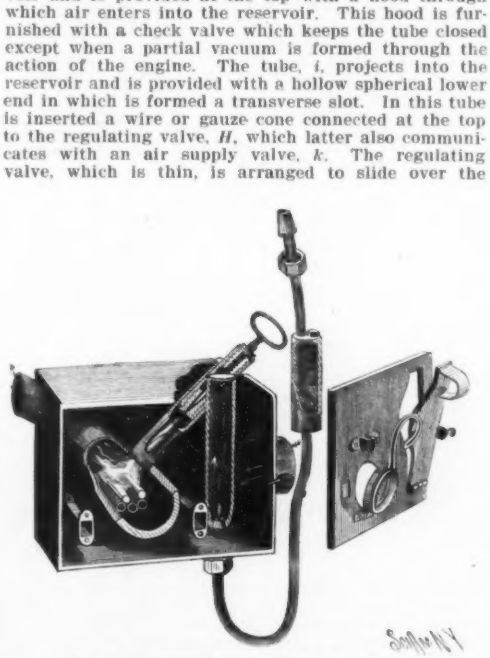


FIG. 5.—IGNITING APPARATUS.

opening which communicates through the pipe, *l*, with the supply side of the valve casing. The proportion of benzine vapor and air conveyed to the engine depends upon the position of the valve, *H*, and this is regulated by the lever, *m*, pivoted to the handle bar and connected with the valve, *H*, by a rod. The lever, *m*, at its free end has a latch which is arranged to pass under a lug projecting from the handle bar when the valve is closed, and when the lever is released to open the valve, the regulating cone screwed on the end of the lever rests against a finger projecting from

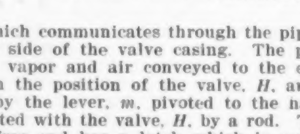


FIG. 6.—ONE OF THE IGNITING TUBES.

the handle bar, and serves to adjust the position of the valve by engagement with the finger as it is screwed along the threaded end of the lever.

The exhaust escaping through the exhaust valve is taken to a hood, *I*, made in the form of a hollow quarter cylinder, which is divided into two compartments by a perforated curved partition. The exhaust pipe enters into the smaller compartment and the larger compartment is filled with asbestos cord. The convex surface of the hood, *I*, is perforated. The asbestos cord serves as a muffler which deadens the noise of the exhaust.

Over the drive wheel is supported a curved water tank which is connected with the water jacket surrounding the cylinders, and the circulation of water serves to prevent the overheating of the cylinders. Strong elastic bands are connected with the connecting rod and with an arm mounted on a rock shaft at the top of the cylinder. These elastic bands may be put under tension to assist in starting by means of a screw at the top of the frame, which is operated by a crank and miter gear. The oil for the lubrication of the cylinders is contained in the upper oblique tube of the frame, and is fed to the cylinders by a sight feed, *o*.

To start the motor cycle, the reservoir, *G*, is partly filled with benzine or gasoline; the door at the back of the ignition box is opened and the burner for heating the ignition tube is started by giving it a preliminary heating by means of an alcohol torch. As the door at the rear of the ignition box is opened for this purpose, the air supplying pipe is closed automatically by means

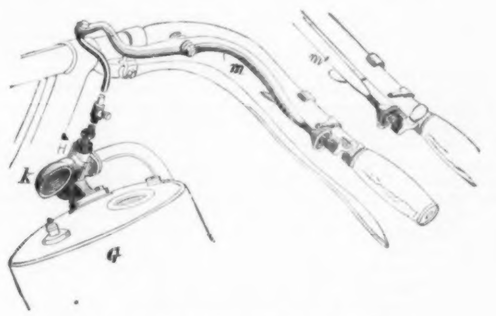


FIG. 7.—VALVE CONTROLLER.

of a connection with the rear door. When the tubes are red hot the valve, *H*, is opened, the rubber bands put under tension and the machine is moved forward by the operator until an explosion occurs, when he mounts the machine and proceeds on his way. The proportion of the supply of air charged with petroleum vapor and pure air is regulated by the valve, *H*. By manipulating the cone on the lever, *m*, the supply of explosive mixture, and, consequently, the speed of the machine is regulated. When the machine is fairly under way, the tension of the rubber bands is released.

The action of the machine is as follows:

The forward motion of the piston draws in the explosive mixture through the valve, *H*, as already described. On its return, it compresses the explosive mixture in the explosion chamber behind the piston, and a portion of the mixture is forced into the hot tube, where it is ignited, forcing the piston outwardly, giving the propelling impulse. The return stroke of the piston expels the products of combustion through the exhaust valve, which is opened by the cam, *B*, at the proper moment through the agency of the roller, *a*, and the hook, *D*, as already described, and the cylinders operate in alternation, thereby giving one effective impulse for each revolution of the drive wheel. To stop the machine, it is only necessary to close the valve, *H*, and apply the brake in the usual way.

The engine cylinders are 3 9-16 inches in diameter, with a stroke of 4⅝ inches. The supply and exhaust valve apertures are ½ inch in diameter. The benzine reservoir is 13 inches long and 7½ inches in diameter. The driving wheel is 22 inches in diameter and the guiding wheel is 26 inches in diameter. The pneumatic tires are made specially large and heavy to support the weight of the machine and rider. The tread of the machine is 4 feet; weight when in running order, 115 pounds.

The reservoir contains a supply of benzine sufficient for a run of 12 hours. The machine is able to run at a speed of from 3 to 24 miles per hour.*

IMPROVEMENTS IN THE MANUFACTURE OF CELLULOID.

IN the manufacture of celluloid there is one point on which all researches bear. This is the exclusion of camphor in the composition. The price of camphor is comparatively high, with ever an upward tendency, for the reason that the production does not equal the demand. Accordingly, attempts have been made to obtain celluloid without its aid.

The first of these attempts was the substitution of naphthaline for camphor. The former, as well refined as it may be, always has a strong odor, but the odor, it is said, will disappear, like that of camphor, when the celluloid product has been exposed to the air for some time.

An improvement is due to M. Zühl, who employs, instead of camphor, naphthyle acetate. This material, according to the patentee, has, like camphor, an exceptional facility for dissolving nitro-cellulose, and the celluloid product thus treated is inodorous.

It can be manufactured, for example, in the following manner: 1 kilogramme of acetate of naphthyle B is melted, and 1 kilogramme of nitro-cellulose is gradually added. A diaphanous product is obtained, similar in all respects to celluloid, but odorless.

Different starches have been tried, but these substances have not given satisfaction, as they have the disadvantage of decomposing very easily, and dissolve the nitro-cellulose imperfectly. As is well known, in order to obtain a good product, a very homogeneous mass must be secured and the nitro-cellulose completely dissolved in the special material added.

The process of MM. Peschard and Mestrallet may also be mentioned. The formula of their product, named "Uninflammable Celluloid," is the following:

White gelatine, acetate of aluminium, fish glue, zinc oxide not pressed, and amalgamated salt.

As no proportions have been given, the conclusion must be drawn that all these products are mixed in equal parts.—Translated from La Revue des Produits Chimiques.

* In SUPPLEMENT 998 is contained an illustrated description of a slightly different form of motor cycle.

TUBES WITH SIDES AND WITHOUT, IN SHIP RESISTANCE—AN EXAMPLE FROM LORD KELVIN.

By MARSTON NILES.

1. LESS than thirty years ago the present or stream-line theory of ship resistance was adopted by naval architects, but it has long been held by mathematicians. It is shown in the six graceful curves of Fig. 1, taken from the treatises of Naval Constructor Taylor, U. S. N., and Prof. Durand of Cornell University, and in the straight lines into which the curves turn at a distance. By a single horizontal cut through her at the surface of the water, the vessel has lost all her upper portion. Water and ship are covered with an unbending sheet of frictionless ice, and beneath this and touching it she is steering north. A like sheet, parallel with the other, lies along her bottom. Both of these stretch to a very great distance on every side, and prevent all up and down movements. The curved lines seen about the vessel are the nearest members of an endless series which slice the whole expanse into so many independent streams. We might slice it into a hundred or a thousand times as many, all not so broad as deep, but none of them carrying more water than another; we might even have the streams no wider than a single file of particles. The lines or banks which divide them are immensely long strips of frictionless cast iron which in the figure are beheld edgewise through the ice. They are insensibly thin but unyielding. Each is fastened to the others, and all are fastened to the ship, and they and she are marching as a single body. Along their upper and lower edges the iron strips touch so evenly the ice-sheets between which they are traveling that there is no leak between ice and iron, yet the whole configuration slides smoothly northward. The skin of the ship, *s k i n*, and the mid-line, *n b*, taken together, form the inner bank of the inmost "port" stream, and in this stream the invisible innermost file of particles (which may or may not be reckoned a stream by itself) *hugs this bank and everywhere touches it.*

2. Ahead of the ship, a glance would show the strips drawing together a little at the first, but every inch of northing brings them straighter and more nearly parallel. At some length ahead (as shown in the diagram) they become sensibly both straight and parallel. The bulge or broadening just off the bow at *i n*, made by the excess of pressure there, gives room for the congestion caused by the shock of the particles upon the bow and the consequent delay. Hard by the ship is where the difference of pressure between the streams is found the most striking. Any pressure difference between two neighboring streams is pointed out (and indeed is proved) by a corresponding difference between their breadths. Fig. 2 shows the system in miniature. Right ahead and off the bows is the greatest pressure, and there the streams are broadest, and each stream is broader and has a heavier pressure than its neighbor on the outboard hand, i. e., than the stream next farther from the mid-line, *b n*. Along the mid-line the pressure is the heaviest of all. The weakest pressure is abeam, at *e, e', e''*, etc., and there the streams are narrowest, *and each is narrower than its next outboard neighbor and has a weaker pressure.* In the distant offing everywhere the streams are sensibly straight, of equal breadth, and parallel.

3. Of course each pair of strips, along with the top and bottom ice-sheets between which they and the ship are marching, forms a water-tight pipe, or "tube" as it is called, of right-angled cross-section and enormous length. Returning to Fig. 1, we see that at a point well north, e. g., between *p* and 1, the tube has become dead straight; and from there onward the breadth of its cross-section is found no narrower. Still further in the north each tube is fitted with a smoothly-slipping slug or piston, *p, p'*, etc. On its north side each piston has a very long handle, *h, h'*, etc.; and all handles fasten stiff to a single cross-piece lying due east and west. If we should push this cross-piece steadily southward, the pistons would be forced down the tubes toward the vessel through equal lengths and with equal swiftness. If we do not wish to get the moving force from pistons, we can do away with those and have the gush of sundry springs or "sources" welling out of the far north. The springs all have an equal strength of flow; they lie side by side, in row east and west, each spring answering to its own tube exactly; the tube goes well into the vein of the spring and the fit is cemented.

4. The motion is seen more easily from on board the ship, if we let her and the tubes stand fast and have the water flow past us. This is opposite to what we began with; yet all motion is but relative, and so the theory is wholly justified. The water now rushes down the tubes before the steady push of the pistons, or before the steady flow of the springs. Look at the inmost port tube, *p* 1 1 *x e*, in Fig. 1. It has to stay with the ship, however strong the flow. It will not stretch out longer. The shape or bend of it cannot be changed. The water is incompressible and the piston (or the spring-flow) is irresistible. Particles which have been dallying between *i n* and *i' n'* in the broads will be sent shooting through the narrows at *e x*. Clearly the tube is a syringe, with the narrows for nozzle. The iron has been shaped exactly to a stream-line pattern, and the stream takes that shape exactly. This way of moulding the stream to a carefully-designed figure has been adopted by Prof. Hele-Shaw in those beautiful film-experiments which have generally been thought to prove the truth of the theory, and which for other purposes are certainly invaluable.

5. With equal readiness the theory takes up the situation in reverse, viz., where the vessel is what travels and the water is the standing body. To bring this about, we first brace firm the cross-piece (see Fig. 1) into which the piston-handles are mortised, and then we push the tubes and ship northward as a single body. The pistons, however, cannot move with the tubes, since their rigid handles have a backing against the well-braced cross-piece. Thus the syringe is now a force-pump having a back-action through the narrows (between *s* and *s'*) abeam of the vessel; and the motion of the particles is displayed for Eulerian investigation. On the other hand, when we kept fast the ship-and-tube system, and sent the pistons evenly down the tubing with a square southward movement of the cross-piece, we had the Lagrangian system, in which the water is taken as flowing past a vessel at her anchors.

6. The shape of each of these tube-streams is peculiar to the stream, and its peculiarity springs from two jointly-acting causes. The first cause is a purely ideal one which the theory bids us weigh by itself, all sundered from the metal stuff which has been moulded to that pattern. It is simply the *form* possessed by the particular tube, a form distinguishable from that of every other tube. Only through looking upon this form as a disembodied ideal or as a conceptual essence, can we really come to understand the theory. The second cause is *a state of equilibrium between the following sets of forces*: One set is found in the *vis viva* of the particles as (Fig. 1) they strike against the bow at *i n*. Before this shock the bow, however massive, cannot but give ground at first, although insensibly; but its reactive forces at once awaken and they heave back against the outer wall, at *i' n'*, etc., the whole onslaught. On the other hand, the fluid particles hurled over now against that wall must bend, though insensibly, its iron; and in so doing they awaken cohesive forces which have been sleeping among the particles of the metal. Instantly these forces resist and react; and between the action of the liquid particles against the wall, *i' n'*, and the reaction of the wall's solid particles against the liquid, there comes at once the equilibrium which is essential in the theory. For without this equilibrium, the wall, *i' n'*, might be bent sensibly, or might indeed be burst; in which case it would not be able to guide the fluid, or at least not guide it as the theory requires.

7. Yet it is only for a temporary purpose that the theory has framed this complicated mechanism. The use of the coarse device of pistons and a gross material tubing is merely to help us understand the theory's fine equilibrium and its peculiar movement. Grasping these last as ideals firmly, we now fling away the stuffs or matters which had been sent into the form of tubes and pistons, and henceforth hold only to *the abstract shape or pattern of* the streams. A perfect equilibrium between the *vis viva* of the stream, *p* 1 1 *x e*, for example, and the *vis mortua* of its restraining wall, *i' n' b'*—an equilibrium we had earlier gotten only by stuffing the ideal wall shapes with actual materials—the theory now informs us is a native quality in every fluid, and that here the fluid particles in line will serve for a wall quite as effectively as if they had been frozen solid.

8. For the theory plants itself squarely on a hydrostatic doctrine which has been taken over into hydrodynamic science. This is that *every fluid particle is pressed upon with equal force by all its neighbors in every direction.* Take the line, *b' n' i' k' s'*, for example. Along this line, where earlier we had a wall of cast iron and now have nothing but a row of liquid corpuscles, the theory says there exists with every corpuscle an inborn and perfect equilibrium. It says that the pressure from shipward against the inboard side of that line, which tends at *i' n'* to drive it northwesterly or away from the vessel's bow, is exactly balanced by an equal and contrary pressure against the outboard side of it, tending t drive it southeasterly or shipward. All needless, then, the curbing metal. Equipoise alone will brace that mental or immaterial bank against the heavy bow-pressures. And along that line, says the theory, the equipoise is no less genuine and effective than that seen along the mid-line, *b n*—a line which, though equally nonmaterialized, we know will let no particle stray from starboard to port or from port to starboard.

9. The object of the present paper is to show, on the contrary, that the equipressure doctrine can by no means be brought into hydrodynamics, except in hydraulics or with the use of substantial pipes and tubes whose solid walls, placed *vis-à-vis* and reacting each against the other, both conserve within the stream limits the tube forces, and also bestow among them the equilibrium demanded by the equations; and excepting also with heat, electricity, etc., in all of which phenomena there is that reciprocal, vibratory or back-and-forth motion whose equilibrial swing implies a nugatory march, an average equipoise and a general equipressure. The thing is not too difficult, but it may be too simple, for instant comprehension. In hydrostatics, or fluids at rest, an equality among the pressures from all quarters upon every particle is what keeps each particle motionless and maintains the hydrostatic plight. In hydrodynamics or moving fluids, on the other hand, a pressure from some quarter stronger than from others is what compels the motion and brings in the hydrodynamic *rôle*. For particles are not self-moving. They move only as they are pressed to move. *And if particles are not pressed more strongly from one direction than from others, they will move no more in one direction than in another, or in other words they will not move at all.* If we part with equipressure we part with statics. Unless we part with equipressure we cannot have dynamics.

10. In his paper "On Some Cases of Fluid Motion" (Trans. Cambr. Phil Soc., Vol. VIII.) Sir George Stokes makes the following keen observation: "The equations of hydrostatics are founded on the principles that the mutual action of two adjacent elements of fluid is normal to the surface which separates them, and the pressure is equal in all directions. . . . In hydrostatics the accurate agreement of the results of our conclusions with experiments (those phenomena which depend on capillary attraction being excepted), fully justify our fundamental assumption. The same assumption is made in hydrodynamics, and from it are deduced the fundamental equations of fluid motion. But the verification of our fundamental assumption in the case of a fluid at rest does not at all prove it to be true in the case of a fluid in motion, except in the very limited case of a fluid moving as a solid."

11. This was written in 1843. Many years later, in these days of fast ships and experiments with models, the shrewd suspicion of this prince of science becomes fully justified by the absolute contradiction between the calculated results of the equations and the actual facts discovered by experiment. Mischief has been scented by other distinguished mathematicians. "Let us eschew the notion," said Poinsot, "that a science has been made when it has been reduced to mathematical formulas." Only two years ago, in his presidential address to the American Mathematical Society, Prof. Woodward observed as follows:

"Lagrange and most of his contemporaries in their eagerness to put mathematics on a sound analytical basis overlooked to a serious extent its more important physical basis. . . . It must not be inferred . . . that the simplicity of the phenomena of fluids in a state of relative rest extends to the phenomena of fluids in a state of relative motion; for the gap which separates hydrostatics from hydrokinetics is one which has not yet been fully bridged even by the aid of the most powerful resources of modern mathematics."

And referring to purely theoretical investigations, Prof. Osborne Reynolds has also said: "As regards the direct object in view, the revelation of the actual motion of fluids, the research has completely failed. And now that generations of mathematicians have passed away, . . . the simplest problems of fluid motion are yet unsolved." (Proc. Roy. Inst., February 2, 1877.)

12. I think it is upon the assumption of equipressure in fluid dynamics that we now may put the finger, declaring it the unsuspected but potent sire of the whole set of monstrous misconceptions and nugatory or abortive calculations. The proofs of this paternity are endless in number. Let me offer a simple specimen. In Fig. 3 we see on the right a great chamber having very strong walls. The top side, *s' s*, is a piston. On its left is a narrow cylinder whose mouth shuts tight with a cap screwed on at *s'' s'*. Both cap and mouth have the same cross-section as the cylinder. From *s'* to *k'* there is an unbending and unbreakable wall between the two ves-

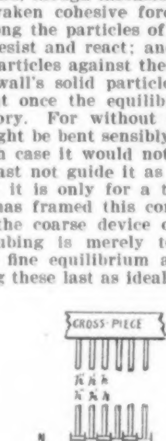


FIG. 1.

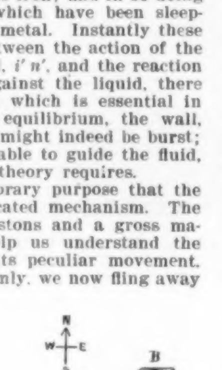


FIG. 3.

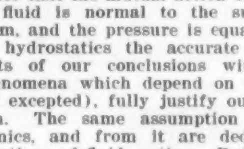


FIG. 5.

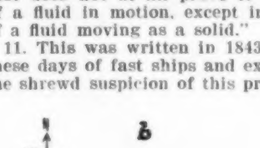


FIG. 6.

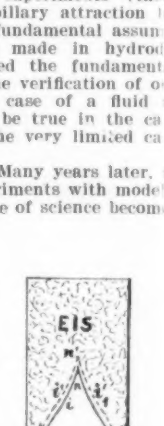


FIG. 9.

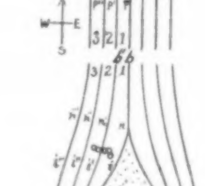


FIG. 2.

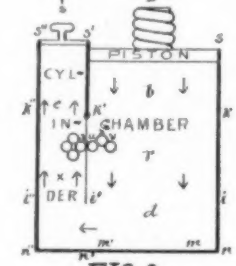


FIG. 4.

F I G. 8.

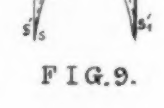


FIG. 7.

sels; but from k' to i', the only division is the thinnest possible curtain of India rubber. The opening, i' n', has the same area as the cylinder's cross-section. Both vessels are full of liquid. The small circles seen on either side of the curtain may as yet be disregarded. A spiral spring, of strength equal to a ten-ton load, is placed upon the piston, begetting a fearsome pressure in the fluid of the chamber. This pressure, however, does not budge the curtain, k' i', a hair's breadth. The curtain would not budge if a mountain lay upon the piston. Altering again and again the plan of the machine, we might shift the cylinder and the curtain so as to bring the curtain successively against each particle in either of these compartments. If the cap is only tight, the curtain will still be motionless.

13. The reason is that in hydrostatics, or unmoving fluids, the urgencies are not only felt all at once in every quarter, but also are instantly sent back thence, and therefore the pressures from all directions against each particle are ever equal. For along the curtain k' i' (Fig. 3), on the cylinder side of it, pick out some particle, say a, that touches the curtain. If the pressure against the right side of this particle, proceeding from neighboring chamber-particles and transmitted through the yielding curtain, were greater than the pressure against the left side of it which proceeds from its companions in the cylinder, then the chamber-particles would push the cylinder-particle leftward. And in turn about, were the pressure against its left side, from its companions in the cylinder, greater than that against its right side, sent by the chamber-particles through the curtain, then the particle would be pushed over toward the right. In either case the curtain would be swayed with the pushing. In point of fact, however, the curtain does not budge. Now since both in cylinder and chamber each particle can be tried in like manner, yet never save with like result inevitable, and since with each a motion can be brought about only by more pressure in some direction than in others, and since non-motion can be maintained only through a non-excess of pressure in any direction, it follows that equipressure in all directions is the fundamental principle of fluid non-motion, i. e., of hydrostatics.

14. On the other hand, if we take off the cap and let the fluid shoot out of s'' s', on a sudden the curtain flies leftward. The next instant will find some part of the curtain pressed against the left wall of the cylinder, and the flow will be halted. If instead of a curtain of rubber, we have a plate of thin metal, k' i', swinging on a hinge at k', and held immovable at perpendicular until a current has been fairly established, and then let the plate go, it goes left as before. In either case the reason is, that the chamber-particles in touch with the curtain are now sending through it a heavier pressure against the side of any cylinder-particle in touch with the curtain, than its cylinder fellows are sending against its left side; therefore the cylinder-particles can only give ground and go toward the lesser pressure. It is plain now, that against any particle the pressures from different directions are not all equal. Non-equality among the pressures must in fact be reckoned the fundamental principle in the dynamics of a fluid; because non-equality, as we have seen, is what founds the *dunamis* or the Might that sends the motion.

15. We may pierce a good-sized opening, even wider than i' n', in the bottom of the chamber anywhere, as from m' to m; the spring still pressing against the piston. The curtain will go leftward as before, although less swiftly. For the motion of the chamber-particles (u, x, v, etc.) along the right side of the curtain is through a wider channel and therefore is slower than that of the cylinder-particles along its left side; and it has been established by experiment that of two neighboring streams having equal strength of flow, if other things are equal, *the one whose motion is the slower has always the heavier pressure.* It was by the general principle that "the average pressure is least where the average energy of motion is greatest," that Lord Kelvin explained so deftly the tremor experiments of Guyot, Prof. Guthrie and others—phenomena which some had thought would solve the mystery of gravitation (Clerk Maxwell on Attraction, Encyc. Brit., IX. ed.; Lord Kelvin in Phil. Mag., 1871).

16. A ready proof of Lord Kelvin's principle is found in the movement of the nostrils while a long swift breath is drawn in through them, the mouth being shut meanwhile. Suddenly they near each other. They do this because the streams of air-particles pressing upon them from the outside are broader and thicker, and hence flow more slowly, and therewith possess a stronger thrust sideways than those from the inside, although the latter have quite as great a strength of flow. This bringing together of the nostrils is by no means muscular, for it cannot be effected except while taking a breath.

17. Misleading, however, both in the foregoing examples and those in which Maxwell and Lord Kelvin have applied it, would seem the broad doctrine that "the average pressure is least where the average energy of motion is greatest." If this assertion may be said to account for these phenomena, does it answer the underlying question, *How?* By what actual steps? Is any assertion valid but that of some mechanical power? The unequal-velocity explanation seems like the præ-torricellian explanation of water's mysterious uprising in an ordinary pump, viz., "Nature abhorreth Vacuum." True, in a way, yet occult and not sufficiently materialized. The miles of upper air, down-thrusting on the reservoir with near a ton of push against each square foot of area, are the means whereby Nature lets Vacuum feel the weight of her displeasure. The misliking becomes impotent beyond three-and-thirty feet. But in admitting that the pressure can be less on one side of a surface in a fluid, and greater on the other side, would not Maxwell and Lord Kelvin themselves be abandoning the doctrine of equipressure which they reckon fundamental?

18. "A pressure," said Young, "is a counteracted force." Now a force cannot be counteracted but by some other and contrary-pushing force. Such counteraction may be only partial; but then also there will be at least some resulting pressure or, in a compressible fluid, some compression. In Fig. 3 the "acting" force is the spring pressing on the piston. The "counteracting" (or *pro tanto* counteracting) force is the cohesive power a-slumber among the solid particles of the chamber-walls; which power the attack now awakens. The escape of the fluid through i' n', the corner-opening, lasts for an instant, and from there to the outlet all the particles for that instant are in motion. The outlet s'' s', is as wide as the inlet or as any part of the cylinder. Therefore in the cylinder, the stream being once set a-going and the counteraction due to inertia being once overcome, there is no longer any counteraction and thus no longer any pressure. In the chamber, on the other hand, the particles encounter very serious counteraction; for the breadth of the relieving outlet, i' n', is far narrower than the sweep of the oppressive marching piston. It is plain, then, that what sends the curtain leftward is not a slow motion in the chamber confronting swifter motion in the cylinder; but it is counteraction in the chamber confronted with lack of counteraction in the cylinder. Counteraction is but another name for pressure. In the foot of such a chamber, as in Fig. 4, pierce an opening at m' m; lengthen the curtain, k' i', to n'; knock out the whole bottom of the cylinder, making there at n'' n' the exit; and let the whole top, s'' s', be made a piston. Now push both pistons southward, taking care to push the piston of the cylinder more slowly than that of the chamber. If true is the doctrine that the swifter the motion the feebler the pressure, the pressure in the chamber will now be feebler than in the cylinder. But no, the curtain still flies leftward. Indeed, the swifter the motion in the chamber compared with that in the cylinder, the swifter leftward is the curtain's movement.

19. Our search for the cause of this phenomenon will not be over till we set eye upon the mechanism by which the curtain is driven. Returning to Fig. 3, take off the cylinder-cap, s'' s', and let a spring force the chamber-piston southward. The particles, u and v, for example, are now urged toward the opening, i' n', yet are retarded by the counteraction sent back to them from everywhere but that comparatively narrow exit. The particle, x, itself urged onward, crowds in between them. The front half of its circumference, where it bears against their circumferences, makes practically a wedge or salient angle, and this wedge crowds into the practically re-entrant angle formed by the rearward semi-circumferences of the particles ahead, and it pries them asunder. Other particles lying along the whole breadth over to k i are pried asunder in like manner, and all the stress is thrown back from k i against the curtain.

20. In Fig. 1, if the bank at s' k' should stand firm, as required by the theory, we should find the same phenomenon; and find it springing from the same cause. In that part of the most inboard stream 1 x e which lies off the bow, the counteraction is greater than in its outboard neighbor, 2 x' e', its exit being the narrower (see Sec. 2, at end); and therefore its particles, by means of that same wedge action, push northwestward or further outboard the division line, b' n' i', between the streams; and thereby along this line as elsewhere they abolish the "steady motion" of the theory. A like greater narrowness, a like greater counteraction and pressure, a like wedging further outboard and a like abolishing of the "steady motion," must all be found ransacking the configuration, because every stream in it has an outboard neighbor of an equal strength of flow, whose exit (e' x', e'' x'', etc.) is less narrow (and therefore throws back northward less pressure) than its own. It is clear the only configuration that can be sensibly permanent is one in which every stream-line will everywhere find itself at balance between sensibly equal stream-breadths and thus equal pressures. But plainly the breadths cannot everywhere become sensibly equal until everywhere the streams lie sensibly parallel. If the ship's course lies in one straight line, n b, the only configuration in which it is geometrically possible to make all the streams sensibly parallel is one in which they are (relatively) flowing past an imperfect, very long, sensible parallelopiped (or actual wedge) of water ahead of her bows, which is perfecting and lengthening itself to infinity and is coming to have at last no sensible motion relatively to her.

21. In the *Engineer* (London, May 25, August 10, 1900), and in the Journal of the Society of American Engineers (vol. xi., No. 3), may be found further demonstrations that the theory is untenable. The results of computation based upon the principles of the theory—results already known to be contradicted by the facts—were there contrasted with actual ship-waves taken by photograph. The contradictions, as I think, were traced back fairly, and with some minuteness, to the doctrine of equipressure. None of those proofs or arguments appear thus far to have been answered, nor do I know of any effort made at answer. It is improbable, however, that they have been found satisfactory in all quarters. That they have not been contested may well be owing to lack of clearness in stating them, and to the newness of the proofs as well as of my contention. I think a number of well-established "examples" in fluid motion should now be closely examined. The best authorities should be taken up in turn, and each example selected from them should be shown to be impossible; and every proof of impossibility should be made strictly ocular. Failing to make such proof, I might at any rate thereby succeed in finding an error of my own. The present paper has room only for an example from Lord Kelvin.

22. Fig. 5 shows a circular disk seen edgewise, lying east and west and perpendicular to the plane of the paper. It is at great depth in a fluid at rest, through which it is moving due north. The two filaments of (relatively) nearing particles which hug on either side the invisible or balance line of the configuration, part company at n, the middle of the disk; and (according to the theory), their corpuscles then pass to port and starboard along the disk's west-and-east front surface; which surface, says the theory, constitutes their "stream-line"; thus the stream-line of each of the pair is plotted to run here at right angles to b n, the line of their relative approach just made from the northward. The port and starboard edges of the disk, originally right angles, have been rounded off with care, in order to be rid of the *infinite velocity* which the theory demands of a particle on its reaching any sharp turn in the bounding solid. "The occurrence of infinite values of the velocity may be avoided," says Prof. Lamb, "by supposing the edge to be slightly rounded" (Hydrodyn., Sec. 73); although, as he reminds us and as appears from the example now to be cited, the theory gives here still a very high velocity. The lay reader may profitably examine observations in Mr. Basset's Hydrodynamics (Secs. 125, 127) and in Helmholtz's "Discontinuirliche Fluessigkeitsbewegungen." It is in his paper "On the Doctrine of the Discontinuity of Fluid Motion" (Nature, vol. 50), that Lord Kelvin resorts to that device for avoiding the embarrassment of an infinite velocity. He takes "a stiff circular disk of 10 inches diameter and 1/10 of an inch thick at its middle, shaped truly to the figure of an oblate ellipsoid of revolution, . . . moved at . . . a velocity of 1 foot per second. . . . While the velocity of the fluid across the equator [i. e., across e or e_1] is 63.7 feet per second, the velocity across each of the two parallel circles [drawn at k and k_1] whose radii are 4.218 inches (the radius of the equator being 5 inches), is only 1 foot per second."

23. Yet on closer examination the east-and-west course assumed by Lord Kelvin may be seen to be impossible. In Fig. 6 it becomes clear that if at a given instant the disk is at e k i n i_1 k_1 e_1, and a given "port" particle at n, then when the particle shall have passed west as far as the "parallel circle" at k, the northward motion will have carried the disk on to e' k' i' n' k'_1 e'_1, and the disk must have swept the particle north as far as k'. Thus the particle's path from n to the "parallel circle" will have been, not west, or in the direction n i k, as hitherto believed, but northwestward to k'. Moreover, the particles which later should arrive at n (to go thence westward like their fore-goers), will by no means get to that point at the time expected. For the first particles, being forced northward by the disk, will force to northward the neighbors on the north, and these last again their own. Such general northward urging, sent diagonally inboard from port and starboard (normal to k' n, k'_1 n), will (through its due north element) affect those particles which ought (relatively) to approach along the mid-line, and it will hinder their arrival. With the disk's constant progress, this northward push (exerted also upon all the other filaments there) will constantly become intenser, and its general effect will become more near due north, and it will also spread still farther northward; making thus a more and more northerly set in all the fluid which lies due north of the whole breadth of the vessel, and wholly debarring the "steady motion" of the theory; so that a wedge-shaped mass of fluid will lengthen and sharpen itself in front of her and will also come more and more to lack motion relatively to her.

24. A like outcome is certain in the standard stream-line diagram Fig. 7. If the particle found at the cutwater, n, when the ship is at s k i n could (as the theory proposes) hug the ship's side throughout, it would still be found, not at s, but at s', on the instant the ship arrives at s' k' i' n'; and the path which the particle would describe in so moving, could by no means be the graceful stream-line curve b n i k s, as universally believed, but the jag b n s', instead. In order, however, for it to follow even the jag, it would have to travel within an actual tube laid along the line n i k s, a tube whose then substantial northwestern wall would fling back shipward the northwestward pushes upon the particles bestowed by the ship's skin (which skin would then form the tube's opposite or southeastern wall); otherwise, as will be seen in sec. 29, the particle will be crowded still further on to the north.

25. If, however, there be given indeed the equilibrium which the theory takes for granted, the equations straightway tell a truthful story. In Fig. 8 let E I S be a mass of colorless mathematical liquid frozen to a solid. It lies just north of Lord Kelvin's disk, thence parted by only the narrowest imaginable vein of colored liquid. The solid mass is braced so that it is immovable. Hence, though the disk is moving northward, the particles of the vein are yet in equilibrium between two equal opposing forces, viz., the disk's northward action and the southward reaction of the immovable solid in front. This vein being the narrowest imaginable, will be emptied by the disk's advance in the shortest imaginable time—a time not practically distinguishable from no time at all. Instantaneous in a sense, then, will have to be the journey of a particle from n, the middle point in front, to Lord Kelvin's parallel circle at k. Due west, practically, will also be its course, or indistinguishable from that predicted by the theory. Now this novel agreement with the theory will be owing solely to the newly-furnished equilibrium. For abolish in any way the equilibrium; for example in the following manner: Let the ice-mass be braced no longer, except by its own inertia, but let the motion of the disk be persistent; and let the ice-mass melt suddenly to a perfect fluid. Then before the thrust of the advancing disk, the melted particles will at once give ground in every direction, but especially toward the north. In the just-melted mass there being now no persistent southward reaction, but solely its own waning inertia, the particles of the colored vein will no longer find themselves in equilibrium, and evidently they will no longer travel due east and west as plotted by the theory, but will be borne northward, as well, along with the yielding melted particles north of them. And with both colored and colorless particles this new behavior will take place by virtue merely of *their fluid quality*—of their being by definition "a substance which if continuously acted upon by deforming force, yields continuously with continuously increasing deformation, so that the ratio of deformation to deforming force *is not constant but increases with the lapse of time*"—a definition, by the way, quite incompatible with the equipressure doctrine. Thus their motion, which the theory asserts is 'steady," can be steady in

that novel sense alone that it is changing steadily in direction and that steadily it dwindles relatively to the advancing disk.

26. In Fig. 5 then, the theory's west course along the disk's front is (finitely) not possible, on account of the disk's meanwhile northward motion. In order to make good the course prescribed by the theory, viz., *b n i k*, the particles, being unable to pass through the advancing disk, must have, along the disk's front, that same *infinite velocity* which, after discovering it at the corners, the masters have hitherto escaped in that neighborhood by the device of rounding them. But with an infinite velocity, as well observed by Mr. Basset (Hydrodyn., sec. 125), there comes of need an infinite minus pressure, indicating that *a hollow has now been formed.*

"It would be necessary," he says, "that at every point of the liquid hollow the pressure should be constant, and therefore the liquid boundary would have to be a line of constant pressure as well as a stream-line; but it is not difficult to show from the formulæ that *it is not possible for a line of constant pressure to coincide with a stream-line, and hence the formulæ fail.*"

He is writing, it is true, of sharp edges or square corners, and not of this straight course conceived as lying along the front of the disk; for till now, I think, no infinite velocity has ever been pointed out as here inevitable; but his observation is quite just in respect to all infinite velocity, whatever the site. Rounded corners, then, cannot save the formulæ.

27. The same insuperable objection intervenes with the ship-shaped solid which Constructor Taylor's brilliant expedient (Trans. Inst. Nav. Arch., 1894) has enabled the theory to treat mathematically as it had treated the old circular and elliptical forms. But no expedient can reconcile fact with fact-denial. In Fig. 9, although the scale is too small to show the "vein" along the vessel's waist, we yet can see the same proof which is afforded by the disk of Lord Kelvin. On the north of the vessel lies the frozen fluid *E I S*, whose south side, *s' k' i' n' i'₁ k'₁ s'₁*, has been carved out to the same ship-shaped form. As in Fig. 8, being immovable, it gives the particles within the "vein" a counteraction just equal to the action of the advancing vessel, and thus supplies the equilibrium on which are based the equations. Here, as in Fig. 8, the fluid in traveling through so narrow a vein cannot but take practically the stream-line course, *n i k s*, the line of the ship's skin. But to get absolute identity with that stream-line, the vein must, precisely as in the case of Lord Kelvin's disk (Fig. 8), be infinitely narrow, and its particles must consequently receive an *infinite velocity.* An infinitely narrow vein, however, allows only an infinitely slight advance to the vessel; and such an advance, being practically indistinguishable from rest, ousts practically the hydrodynamic condition and brings in a quasi-hydrostatic *rôle.* It is doubtful if "the gap which separates hydrostatics from hydrokinetics," and the still from the moving, and the simultaneous from the successive, and equal pressures from pressures not equal, can ever be spanned save by some such bridge as this; yet this one would seem at best but a draw, and we now are caught improvidently upon it with our infinitesimal, and the bridge half swung. For a really infinite velocity, as Mr. Basset reminds us, forbids any stream-line whatever. But let me waste the reader's time no longer in hopeless efforts to break these nightmares to the saddle. In point of fact, it could be only when the ice-mass should be prolonged to an infinite length northward that its inertia would suffice to bestow on the fluid particles along the ship's skin that equilibrium-producing reaction which would enable them to pursue the stream-line course provided by the skin; but even then this course could be followed for only an infinitesimal and nugatory period. If this mass be melted, as indeed is the case, each particle therein will each instant be crowded more and more swiftly toward the north by the advancing ship's accelerating force, and in consequence less and less swiftly to eastward and westward; so that no particle in the mass will preserve "steady" its course of motion, but its course will be changed each instant, becoming ever more and more northerly, and in the end becoming sensibly north.

28. Like the præ-copernican astronomies, the theory is founded upon an optical illusion. Depicted on the eye of a landsman stationed aboard the moving vessel, the particle *n* (Fig. 7) appears to pass from *n*, the cutwater, to *s*, along the course *n i k s*, averaging say south-by-west, half-west, and thus to move in accordance with the theory. This apparent course is the resultant of two motions; only one of which, however, viz., that from *n* to *s'* (or equal to from *p* to *s*) westerly, belongs really to the particle; the other, from *n* to *p* southerly, is only an appearance. In the painting effected upon the retina, this last movement does not come properly from a stroke of the brush (so to speak), but from an unobserved shifting of the canvas. While the bow is crowding the particle a distance *n s'*, westward, the observer himself is being carried a distance *p n*, northward; and with so much distance made by him in that direction he unwittingly credits the particle as having been made by *it* to the southward, and thus he mistakes the curve *n i k s*, one of whose components is his own journey, *p n*, for the genuine path of the particle.

29. But this is not the whole of the illusion. Water looks alike everywhere and presents no *point d'appui* or identifiable place of reference by which the eye may correlate the motions. The ship as a solid object, on the other hand, with its well-marked outline, supplies the lacking means of reference; and from her the untrained observer, even if he is at a fixed station outside the vessel, will instinctively and always estimate the movement. Not until he posits and identifies a number of convenient spots on the watery waste —which easily he may do by scattering there some chips of wood or other floating material—is the glamour broken. When the bow, however sharp, strikes one of these chips, the chip is borne actually somewhat forward, so as at once to change either its distance or its bearing from some near chip not stricken; and then for the first time does he understand that in Fig. 7 the particle which starts from *n*, will (instead of making a southwesterly course, and of being found later at *s*, as the theory depicts), be found not even at *s'*, or due west of the cutwater, *but at a point north of that,* viz., *s"*, having been sent seemingly farther forward than the ship's side which furthered it, although there has been with it no proper rebounding. To make it come to *s'*, we must turn the line *n i k s* into an actual tube accompanying the vessel, as suggested in Sec. 24, and inside the tube must go the particle. The tube, moreover, must be provided with a piston, braced as in Sec. 5, so that the piston will (relatively) travel southward down the tube while the vessel is moving northward. If the piston is lacking, then as soon as the *vis inertiæ* of the water lying about the tube's mouth further northward is overcome, the tube-water

WIND MACHINE.

will be carried bodily on with the vessel. It is plain that the same cantrip sleight haunts also the example given by Lord Kelvin. Between Figs. 6 and 7 the only difference in result is such as springs from the difference between Lord Kelvin's bow-angle (the half of 180°) in Fig. 6 and the bow-angle, *s k i n p*, in Fig. 7, which latter angle may average the half of twenty-five or thirty degrees. In both figures, and in all cases, the northward transportation of the particle will vary as the sine of half the bow-angle. Certain movements which in a viscous fluid become vortical and have therefore been mistaken for effects of friction and viscosity, are pure geometrical and mechanical factors in this hitherto unsuspected headward motion, and they would be found as well in a perfect fluid.

If my theoretical conclusions as above stated may seem unbelievable because contrary to the universal belief of physicists and mathematicians, less believable yet are the results of certain analogous experiments in reducing the wave-resistance, though it was altogether self-standing and apart from any theory whatever that I carried them on. I would thank the reader for a hint of any mistake or oversight into which I may have been betrayed. In a fundamental study of hydromechanics, perhaps as fully as in that of any other science, a man's best efforts to clear his work of errors can be successful in no other sense or manner than that though constantly he will be falling into them, he may constantly be pulled out of some portion of those into which he has fallen. Only unremitting re-examination and many-times repeated experiments can give the student much help in this lifelong process of alternate sinking and emerging. But often the criticism and experiments of others may help him more than can be done by self-criticism and his own observations. For such help (seldom, alas! to be gotten) he should be very grateful. On this account, and also because my meaning in one or more places may not be clear to every reader, I have cut these remarks into sections numbered for easy reference, and add an address.

Army and Navy Club, Washington, D. C.

BEHIND THE WINGS IN THE HOFTHEATER IN DRESDEN.

THE times in which we live make serious demands upon us. There is a spirit of realism abroad. Everything must be real. Things merely indicated will not suffice. This is especially true in reference to the stage. The most refined accessories of mechanics are utilized to assure an appearance of reality. The sinking sun must slowly gild the castle up yonder with a red glow before he disappears behind the mountains. The little village fountain must tinkle its actual waters into the trough below, so that the spectator (induced by the heat of the crowded house, no doubt) feels an intense longing to dip into the trough and quaff a vivifying drink. The sere and withered leaves of autumn fall from the trees with melancholy rustling; through the dark night, the storm howls so that we who sit safely down below in the parquet circle feel pleasantly horrified and fearsome; masses of white flakes slowly heap themselves in corners of windows and cover the roadways and spread over the wanderer who has lost his way, so horrible a winding sheet, that we feel delightfully creepy.

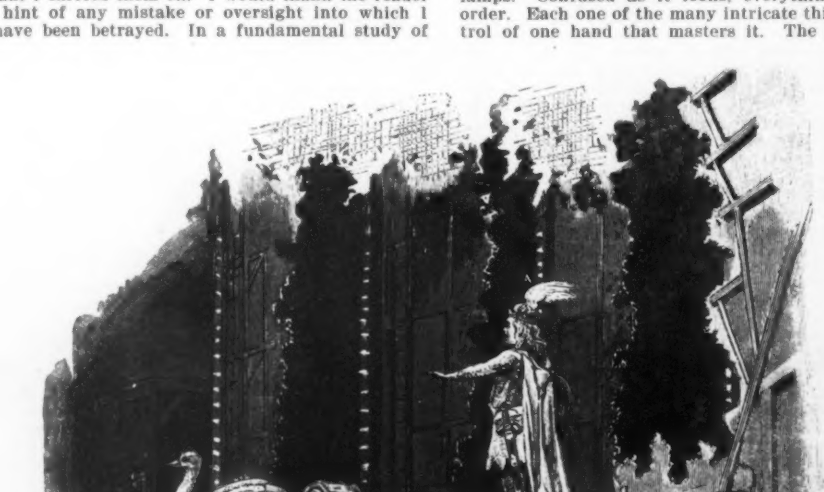
"The vapors rise
To lurid skies,
And the mad flames roar
About window and door,
With flare and flash.
Falling walls crash."

Our hearts beat anxiously. We sit motionless with bated breath.

And here comes the indiscreet scene painter. He turns an amiable and a trifle cynical smile to the audience and says, "Have no fear, gentlemen, the lion is stuffed."

It is not pleasant to expose the bare wilderness of wires that lies back of and within the beautiful world of appearances. But I have one comfort. In this respect, we are like children—anxious to see what is inside of the toys; but, in this case, there is no need of the toys being broken in order to further such examination.

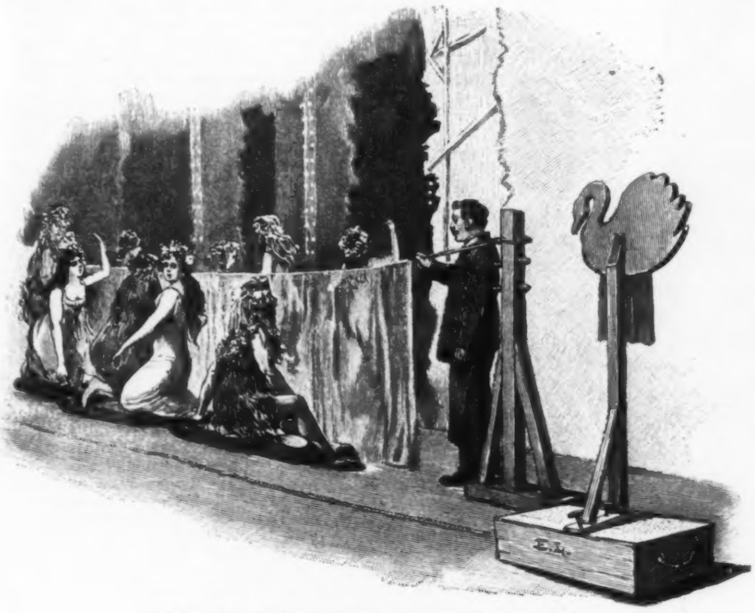
We can enter fearlessly through the little iron door, in spite of its stern admonition, "No admittance," and investigate what there is back of the scenes. We need not fear that anything will happen to us, in spite of the chaos of laths and ropes and linen and ladders and lamps. Confused as it looks, everything is in good order. Each one of the many intricate things is in control of one hand that masters it. The danger to be



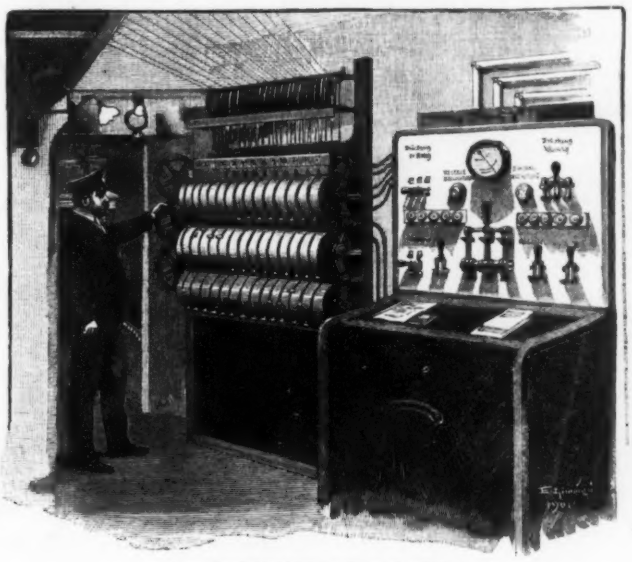
LOHENGRIN'S FAREWELL TO THE SWAN.

most dreaded for the stage, to which many sad theater fires bear testimony, is fire. The first man we meet reassures us as to that. One pressure of the lever alongside of the fireman will pour a deluge of water over the stage from a network of pipes above. In each of the wings stands a fireman with a wet woolen blanket in his hand. The least sign of a flame in the easily inflammable garments of the ballerinas is immediately followed by a wet embrace from this watchman. The introduction of electricity in place of gas in the theater of the "Neustadt," and also in the Opera House in the "Altstadt," has decidedly lessened the danger. We see the master of all of the electric currents, the ruler over day and night, sunlight and darkness, in his central box, into which all the light-bearing wires are concentrated. A little turn of this in a few minutes, and in how brief a time a new, harmonious whole arises out of the chaos so created. Every one of the many workmen knows upon just what object he must pounce as soon as the curtain falls, and everything required for the upbuilding of the next scene lies handy and near. We may pause, if you wish, in passing, and greet the general manager and the musical director, who are in conversation with one of the actresses; then we descend this step on the right to investigate the making of the waves. The stage is covered loosely with canvas, painted the color of the waves and fastened at certain intervals to the boards; this machine blows wind against the canvas and bellies it out, while these ropes serve to draw it downward again at various places. This produces the appearance of the moving sea, through whose rubs against the strip of linen, and the piping northeaster is ready to hand—that is the whole story.

And this storm resembles somewhat the maddened tumult of the people whom we hear muttering in front of the castle. This also loses its charms when seen from behind the scenes. In a corner of the stage the "multitude of the dissatisfied" are gathered together, and the director or his assistant mounts a chair to guide their mutterings and directs its crescendo and decrescendo. If certain expressions of sympathy or indignation are to be heard distinctly, these of course must be spoken at their proper points by one specially deputed to that duty. If the murmur of the people is simply to be a general threatening murmur, designed to frighten the tyrant within, then various methods are adopted to represent that muttering. It is abso-



POSE OF WATERSPRITES IN "UNDINE."



DEPARTMENT OF LIGHTS.

of that wheel, and the lights grow dim, or there is a glimmer of dawn or a pale light of the moon over the scene.

Since the moon has been almost as frequently sung by poets as spring, it is not to be marveled at that the stage should also have a moon which shines equitably over the good and the evil; not only that, but there is extra moonlight for special cases and for special people. Such an especial case is the moonlight apparatus behind the bridal chamber of Elsa and Lohengrin. It is Lohengrin also who initiates us into the mysteries of stage navigation. See him standing on the shore and taking leave of his noble swan, who has brought him to shore in the boat. This boat has no compass, but the stage has a distinct chalk mark which indicates to the swan in what direction he is to swim. O noble swan set on rollers! I hope that thou wilt not be less an object of admiration when those who see thee realize that a couple of men, well concealed beneath thy plumage, are pushing thee vigorously on!

"Be careful of the auger," our kindly leader, the painter, warns us. "These reeds and rushes are fastened with augers so that they can be easily removed during the shifting of the scene. It is almost incredible, gentlemen, into what desperately chaotic condition these most beautiful landscapes can be changed waves the ships of the Flying Dutchman and of the Norwegian make their way. When this is seen from the auditorium, it is difficult to understand how it is done." But this method of representing water is not the only one. There are several. Who does not remember the graceful dance of the water sprites in "Undine"? Here we have them, the dear little sprites, kneeling and lying on heavy cushions between gauze veils which represent their native element. Workmen back of the wings move the gauze, which is fastened to ropes so that it represents the light leaping of the waves naturally. A swan, not the Lohengrin variety, is waiting to be pulled across the stage at the proper moment.

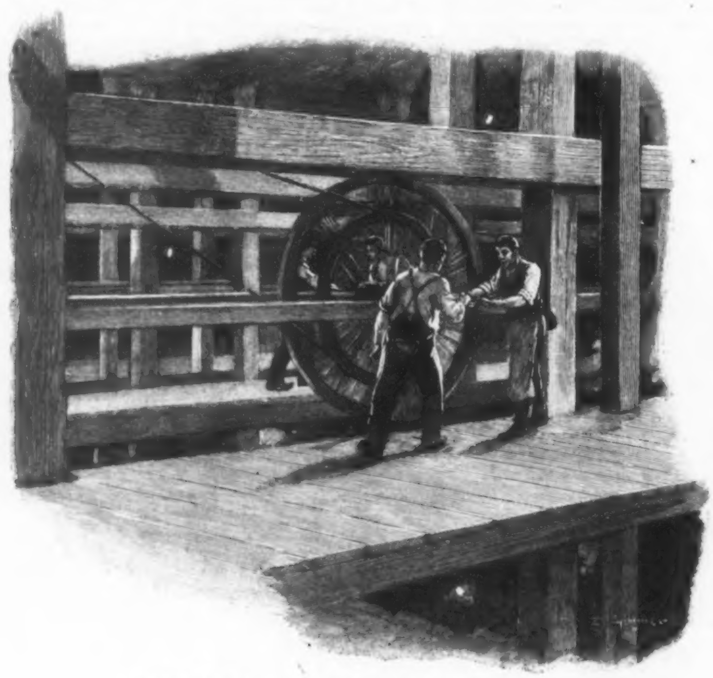
As devoid of danger as is the deep green sea, so harmless is also the storm which curls its white wave crests into flakes and seems to hurl them against the trembling window panes on shore, while cruel Gessler grows pale in his boat. Madly as it hurls, it evidently does no harm, for it does not deprive the lady in the box, who wears so gigantic an apparatus for concealment, of her feathered hat, which surely it would do if it were an honest and upright wind. It is, so to speak, a dog that only barks and does not bite. Here you can see the gentle Æolus who produces the storm on his little machine. The wooden lath in the wheel lutely amazing what remarkable results can be obtained in the simplest ways. You can easily be convinced of that. Try it when there are five or six together; let each take a newspaper, and all read at the same time different paragraphs, in not too loud a voice, and you will be frightened at the "muttering of the people."

Has your heart ever beaten in anxious expectation when you saw Tell aiming his crossbow at the head of his beloved child? You note distinctly how he takes the arrow from the quiver; how he places it on the crossbow; against yonder tree leans the boy; the apple is upon his head; Tell shoots; pierced by the arrow, the apple falls to the ground. A sigh of relief runs through the rows of the orchestra circle. And yet it was all imaginary. The apple on the boy's head is fastened to a string, and the end of the string is in the hands of a man behind the wings. An apple already pierced by an arrow lies on the ground behind the trunk of the tree. At the sound of the cue, the manager snaps his fingers, the apple is suddenly jerked back. Tell's arrow has of course been only apparently shot from the crossbow, and yet you would have sworn that you saw that arrow actually fly.

Now cast your eye into the greenrooms. On the right are those for the ladies; on the left those of the gentlemen. Those exquisite little pages who have be

CHANGE OF SCENE.

just announced the entrance of the king or the queen into the throne room, with the utmost gravity, are now either taking a lunch or they are knitting stockings. This to some of us is rather unexpected, if we have passed through life under the impression that these young pages skip and dance and flirt all their life long. Nay, they can say with Mary Stuart, "I am better than my fame." And here is the companion piece of the Female Chorus; these are the doughty companions of the suffering wanderer, Odysseus. They are taking life easy just now. In fact, they are playing whist.



WIND MACHINE BENEATH THE STAGE.

Here we have reached the exit. But before we depart, our eye falls upon the figure of a man who seems to be half in the upper world and half in the lower. It is the prompter. Ye gods! What the word tells; volumes could be written about him, and the stories told about him! Their number is legion. On his account, France has been asked all manner of questions. What does the actor think of the prompter? Can he be dispensed with? And from an overwhelming majority of actors his utter necessity has been emphasized. Wages and the prompter are the two most important items in the life of the artist. As his physical "to be or not to be" depends upon his wages, so his histrionic "to be or not to be" depends upon the prompter. His favors are sought by the mighty and by the poor. They tell us stories of certain stages where the "world-signifying" boards near the prompter's box are worn away at very brief intervals. They tell——

But of the prompter at the Hoftheater, at Dresden, no stories are told; and that throws a very favorable light, not only upon him, but also upon his clients.

The iron door closes behind us. The man in the first of the wings drops the iron curtain. The play is ended. The painter closes his sketching chart, and we cast back our mental eye upon this world of seeming, and it is even as beautiful as it was before our visit.

For our engravings and the accompanying description we are indebted to Illustrirte Zeitung.

NOVELTY IN PATENTS ACCORDING TO GERMAN PATENT LAW.

THE Chairman of the Society of Chemical Industry recently read a paper which will probably be of some interest to inventors, since it comprises a very acute analysis of the principles of novelty in inventions from the German standpoint.

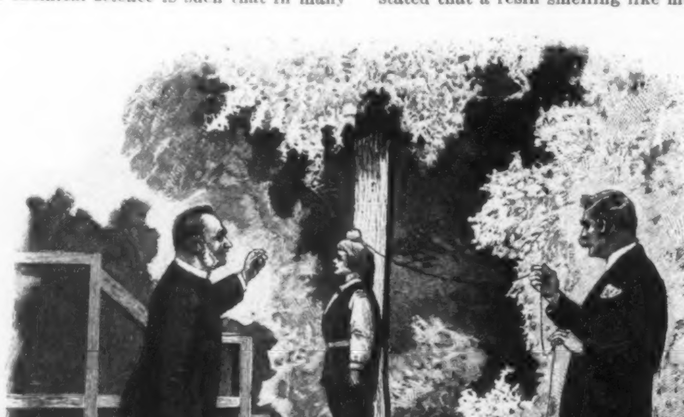
The conditions under which a patent is granted in Germany are mentioned under the statute of monopolies. By the provisions of this statute the invention shall not be contrary to law nor mischievous to the State by raising prices of commodities at home, injuring trade, or causing general inconvenience. As in the United States, it is recognized that an invention must be to a certain extent original. But while it is very easy to decide in ordinary literary work whether an author has simply copied from another, and while in written work the same thoughts put into different language by different men would still be original as far as form is concerned, the case of industrial inventions is different. Novelty is not purely a question of form, but a question of fact. Although the German law recognizes that an inventor should be recompensed by the granting of a monopoly for his invention, it does not in any way discriminate between the relative importance of different inventions; the monopoly is given whether the invention be of great importance or of very little importance; whether it shows a great amount of originality or only very little; whether it is almost the natural outcome of previous improvement or an entirely new departure.

Although the German government does not guarantee that patents granted are necessarily valid, it does to a great extent establish the validity. The German patent acts require that patents be granted for new inventions which admit of industrial utilization. The expression, "new invention," has given rise to much controversy. It is assumed by many that an invention must be strictly new, and by others that something can be new without being an invention, and that there may be an invention which is not new. Caro puts the matter very clearly: "1, patents are granted for inventions; 2, the invention must moreover be new; 3, a new invention must be of industrial applicability;" and the Patent Office is therefore bound to conduct an examination in a three-fold direction. As a matter of fact, it is impossible to determine by law what is new; for nearly every invention may be divided into a number of well-known elements which are simply combined. Individual opinion, to a great extent, determines whether this combination is novel or not. One thing at least is clear—the German Patent Office through the last twenty-five years has adapted itself to the changes which have taken place in technology and is justly taking broader views as to novelty.

It appears that for the last two years the examination of applications for German patents are made chiefly to determine whether the object of the application has been completely published in literature during the past one hundred years. Examination as to whether the object constitutes an invention is now in most cases neglected, and is made only in exceptional cases. This is, no doubt, a relaxation of the former strictness, and yet it appears that further relaxation is still desired by a certain class of technologists. Such a relaxation would particularly affect organic chemistry. Many products which at one time were considered far too expensive ever to enter into industrial application have become quite accessible through later discoveries.

The nature of chemical science is such that in many cases the results can be at once transferred to technical work—a fact which has been acknowledged in German patent law. In France, on the other hand, the laboratory experiment, even when it has been published, does not prevent the taking out of a patent for the same substance. The differences in the views which the law takes are particularly prominent in the case of Bullier's calcium carbide patent.

The facts were the same in Germany as in France. The patent claimed by the German patent No. 77,168 is as follows: "Process for the preparation of carbon compounds of the metals of the alkaline earths consists in heating a mixture of the oxides, carbonates, etc., of the alkaline earths with carbon in an electric furnace." The question arose then whether this claim is anticipated by the previous publication of Moissan. "At the same temperature (3,000 deg.) carbon quickly reduces calcium oxide. The metal is copiously produced, and combines easily with the carbon of the electrodes, forming a red hot fluid calcium carbide, which can be easily collected." In Germany this publication was considered as prior publication; in France, however, it was decided as follows: "A communication made by a member of the Academy of Science, and which does not lead to an industrial result, but establishes simply a case which has been observed in the course of laboratory experiments, that is a scientific fact, cannot constitute a prior publication with regard to a patent which is taken for a process and a new product." The consequences of adopting the French views are clearly seen in this example. As long as on repeating a scientific work it appears that industrial results can be obtained, a patent could be taken according to French law, which as a matter of fact would not disclose more to an expert than the original scientific publication. Thus the conditions necessary to convert the laboratory experiment into a manufacturing process must be worked out in each case by the expert, no matter whether the process is intended for technical or scientific purposes. As a matter of fact it appears that in Bullier's carbide patent those conditions which were found to be necessary in order to get over the difficulties of making carbide on a large scale, and without which it would have been impossible to introduce the process as a manufacturing process, were neither mentioned in the German nor the French patent application; so that what might have been unquestionably patentable remained unpatented, and was not disclosed to the public. The law thus protected what experts already knew, while the further knowledge which was absolutely necessary was not published. The conception of an invention as constituted by the present law is particularly suitable to prevent such cases, and should therefore not be altered. The restriction to 100 years in prior publications with regard to novelty is of some importance to chemical industry. In an action for novelty against the lanoline patent, passages from Pliny and from Pharmacopœia of the middle ages were quoted against this patent, which as a matter of fact has become the foundation of an entirely new industry. Still on reading these old publications, any modern chemist would assume that statements mentioned in them, and not confirmed by later observers, were likely to be incorrect. The conditions under which experiments were carried out and observations made in those days were so different from those prevailing at the present time that these old statements require confirmation by later investigation. On the other hand, by the light of present knowledge a great deal may be found in old publications which has some remote bearing on modern problems. We need only draw attention to the fact that for instance Cavendish threw out hints with reference to the existence of argon, but that it was always assumed that there was an error in his observation. But although these old publications, even when they describe a process completely, are of no value to the modern technologist in his practical work, still they may be brought forward as objections to new inventions. In Marggraf's Chymische Schriffen it is stated that a resin smelling like musk may be obtained



TELL SHOOTING THE APPLE.

from amber oil and nitric acid. But amber oil contains butylxylol, from which, by nitrating, Baur obtained artificial musk. The use of liquefied air in mines might be considered to have been anticipated by A. von Humboldt's proposal of using oxygen. A description of the safety explosives, roburite and helhofit, may be traced as far back as the sixteenth century, that is, to a time when no one would have thought of safety explosives. Such publications will

not always interfere with the priority of a patent, but they may cause the patentee considerable trouble. It is, therefore, perfectly correct to leave out the question of old publications, particularly as they are often written in obscure language, and as we cannot examine them in the light of our present views. The question will, of course, arise, whether the limit put down by the German law is the most suitable limit. The fundamental idea of a restricted period is no doubt this, that only such literature should come into consideration which existed at the beginning of our modern industries. But as we are advancing in years, while the origin of the modern industries is practically a fixed point, it would be better to fix the date, and assume the year 1800 as the date from which publications should be admissible. This question is of considerable importance, as in the course of time the one hundred years limit would bring us to a period when industrial processes were fully discussed and published in such journals as Dingler's Journal.

What protection should be accorded for processes for the preparation of intermediate products? Take, for instance, the azo colors, which owe their development mainly to the naphthol sulphonic acids, dioxynaphthalinsulphonic acids, naphthylaminsulphonic acids, amidonaphtholsulphonic acids, and so on. The importance of these intermediate products is also particularly evident in the process for the manufacture of artificial indigo. As long as it was only a question of analogous processes, that is, of the application of methods which had been used for practically the same purpose with compounds of analogous constitution, the views and decisions of the Patent Office with regard to new processes varied. For some time patents were granted for the preparation of new substances, even if only a certain application of the compound would yield a coloring matter of new technical effect, and a patent was granted for the preparation of an intermediate product. But the Patent Office sometimes changed its position, and would at another time refuse a patent if by an analogous compound a new chemical compound had been obtained by using which the applicant produced a new available color. In such cases a patent only for the preparation of the new available color would be granted.

The difference between the two views taken in judging these matters is as follows: When the process for the preparation of an intermediate product is generally protected, the use of the product by another party for the preparation of a color depends entirely upon the permission given by the owner of the patent for the intermediate product. If, however, the process for the manufacture of a special color is patented only in such a way that the preparation of the intermediate product forms but a link in the preparation of the color, the intermediate product may be made by anyone so long as it is used for the preparation of another color or product. The patent for the preparation of the color makes intermediate products and its preparation generally known without protecting the inventor further than as far as its use for the preparation of a particular color is concerned. As in most cases an intermediate product may be used, not only for a single color, but for a further series of colors, it leaves it open to others to use every intermediate product for experiments, which may lead to important results in other directions than those pursued by the original inventor. In that case, of course, the original inventor would receive no remuneration, whereas, otherwise, he would have a claim on any further inventions, dependent upon the use of his intermediate product.

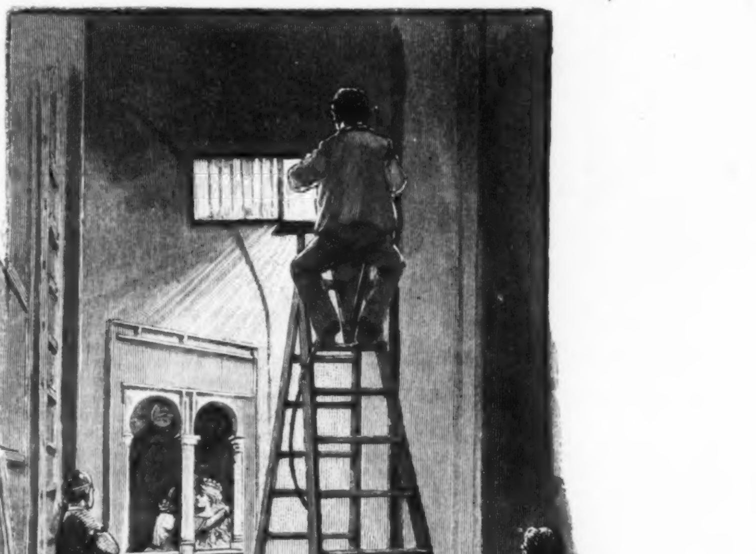
It is indifferent as far as patentability is concerned whether the product is of technical importance, unless technical importance is just the point on which the inventor bases his claim, and which can only occur when the product is a new chemical compound. Thus, if the process for the production of phthalic acid, according to patent 91,202, had not been patentable for any other reason, its patentability would not have been justifiable on the ground that phthalic acid was an article which was wanted, and of importance. But the circumstance that the presence of metallic salts, during the action of sulphuric acid on naphthaline, produce such an extraordinarily favorable yield in phthalic acid justifies the grant of the patent, assuming that it makes no difference in patent law, whether phthalic acid was at the time of technical importance or not.

Up to quite lately both the German Patent Office and the German courts of justice agreed in their views that there was no doubt as to the technical applicability of intermediate products. But in the latest decision of the High Courts of Justice on the ionon patent, there is a passage which denies the industrial applicability of intermediate products.

The claim of the ionon patent, 73,089, is as follows: "A process for the preparation of a new perfume, called ionon, from citral and acetone, consisting in condensing the two compounds mentioned by alkaline agents, first into a new ketone, pseudo ionon, and in converting the latter or its condensation products with phenylhydrazin or other ammonia derivatives by acids into a ketone isomeric with ionon." The decision of the High Court was as follows: "The invention, therefore, did not exist in this process, but only in the process as far as it yielded a new substance valuable in technology. The intermediate product was not an industrially applicable new substance."

The whole question, no doubt, is in close connection with the conditions of the German patent law, by which an invention is patentable, where it shows a new technical effect. What forms a technical effect is independent of scientific or theoretical considerations, but should be decided by those who are directly interested in the matter, that is, those who are engaged in chemical industries. If technologists can agree how a technical effect is to be interpreted in general cases, the law must follow the views which the technologists take, but in that case it would be necessary that all technologists should agree on the point, and not only those who have particular interests in a particular case. Here we come to a most important point, which does not only affect the German law, but the English law, that there are many clashing interests in connection with the patent question, and that the interest of the inventor and the interest of those who may through that invention either gain or lose money are different points. As far as the German law is concerned, it is clear that if the views as regards patents of intermediate products undergo any alteration they will effect an alteration in the future as to the rescinding of patents. In section 11 of the Patent Law, No. 2, it is laid down that after the lapse of three years from the date of publication of the patent, the patent can be rescinded, if in the public interest the granting of licenses appearing necessary the patentee has refused to give licenses against adequate remuneration, and sufficient security; but so far, according to decided cases, "public interest" is not affected, if the later inventor without permission of the holder of the raw material patent may not use his own invention. If the question of patenting intermediate products is to be decided on a broader basis, this point will have to be altered and be decided in a broader sense. If the necessity for giving license is not increased, patents on intermediate products may prevent the carrying out of later inventions in a considerable degree.

This matter of intermediate products may be of far-reaching effect in the course of time and shows more clearly than any other the clashing interests which must be considered in the formulation of patent laws. There is one particular lesson that we should learn from German experience, and that is that in searching for novelty it will be no use to go back only to published specifications of patents, but that it will be necessary to consult literature in general. But perhaps the most important point, and one that it has not been able to touch on is this, that in any alteration of the patent laws it should be clearly laid down that wherever anything has been mentioned in previous patent publications, which has evidently never been worked or even tried on a practical scale, and which has only been put into the specification for the purpose of extending its scope in an unlimited manner, and of preventing others from ever touching the subject, should not be considered as previous publication.



MOONLIGHT APPARATUS FOR THE BRIDAL CHAMBER SCENE FOR LOHENGRIN.

THE MANUFACTURE OF RUBBER PACKINGS.

By JOHN S. MCCLURG, M.S.

WHENEVER a large number of the operators of the manufacturing industries become compelled to use any certain article in the operation of their respective plants, that article naturally becomes an object of interest to them. Is there a mill or a factory which can be operated without rubber packing being used somewhere within its confines? No.

Every engine has its joints made tight by an application of rubber packing. Rubber packing is, therefore, an interesting article to the whole of the industrial world.

In this connection it may be interesting to state that just in proportion as rubber packing is so universally used and useful, the details of its manufacture and construction are as little known to the great multitude of consumers. There is no manufactured line to-day about which so little is known by the general public—and even the consumers—as the rubber line.

As in the case of most products of the manufacturers' skill and enterprise, there is an almost endless variety of rubber packings on the market. These varieties naturally range in quality from the cheapest shoddy packings to the medium and best grades. Every manufacturer of mechanical rubber goods turns out his own brands of packing and claims for them such merits as will have the greatest weight in influencing a prospective customer.

In purchasing a rubber packing which will best meet his needs, the consumer must rely, more or less, upon his own knowledge of the quality, based either upon experience or else on the appearance of the goods. It is not the purpose of this article to praise or to recommend any particular brand of packing, but to give to the readers of The India Rubber World considerations on the methods of manufacture of this most useful class of goods.

A question of vital import to every manufacturer is: "What disposition can be made of the scrap waste and trimmings which accumulate about every factory?" To no class of manufacturers is this question more important than to the manufacturer of rubber goods. The proper solution of this important problem has meant to many industries a vast increase in wealth. In many cases this waste product—which formerly went to the sewer or scrap pile—is now converted into useful merchandise, and in many instances the revenue derived from this source has proved sufficient to defray all the expense of operating the factory. In the mechanical rubber industry rubber packing is one of the principal products obtained from the scrap and trimmings collected from the various departments.

To the class of goods commonly known as rubber packing, the various kinds of corrugated and embossed mattings also really belong. They are so nearly identical in conformation, construction, and manufacture that they cannot conveniently be separated into different classes. We will begin, for convenience, with the cheaper grades, and take up each succeeding kind according to grade.

It is essential first of all that every factory, in order to be economically operated, should provide each department with suitable receptacles to receive all the waste and trimmings which accumulate in the manufacture of the different products. These receptacles can be easily removed each day and carried to the mill room, where their contents can be sorted over. Pieces which cannot be worked over again into the original compound are piled away separately to be milled and ground together. This is not only economical, but it also keeps the factory clean and in good order.

The waste having been sorted, it is ready to be milled. The mill should be warmed up to a moderate temperature and the scraps and trimmings worked through it until they become thoroughly ground and mixed in batches of about 50 pounds. It is important that the batch should become well ground and perfectly smooth, to insure a packing free from lumps and other defects. These batches are piled away and are ready to be mixed with other compounds.

The very cheap grades of packing consist of three kinds: C. O. S. (cloth one side), C. B. S. (cloth both sides), and C. I. (cloth insertion). In most cases the two former kinds have a combination of the latter; as, C. O. S. and C. I. The reason for using these insertions and outside coverings of cloth is that, in view of the fact that the quality of rubber entering into the construction of cheap packings is so poor, it

must be strengthened. To use rubber alone for this purpose would be too expensive; hence cloth is inserted to make the packing strong and prolong its wearing qualities.

The method of preparing the cloth, by the way, is the same for all kinds used in packing; hence this description will cover all the different uses it may be put to. The cloth comes in rolls about 38 inches wide and usually about 110-120 yards long and is a good heavy sheeting. It is passed over a series of heated iron rolls to eliminate all the moisture which the sheeting absorbs in transportation and storage.

The sheeting is then taken to the friction calender and coated, that for use in insertion on both sides, and that for the outsides on one side only—that side which is placed next to the gum. The reason for covering this sheeting is to cause it to vulcanize securely to the center and facing of the packing.

The center is next prepared. This part of the packing is made from the batches composed of the scrap and trimmings, and should have some shoddy and compound mixed with it to give it the proper body and firmness. These batches are now warmed up on a mill. The calender is also heated and the rolls adjusted to make the sheet the thickness desired.

Suppose it is desired to make a roll of C. S. O. packing. Hang up a roll of sheeting which has been frictioned on one side, so it will run evenly through the calender, and begin running the warm scrap compound into it. When the compound has reached the proper heat, start the sheeting between the rolls and a smooth even coat of gum is thus spread over the surface of the sheeting.

During this process care should be exercised that all bubbles are pricked to permit the air to escape and to allow the gum to spread evenly over the sheeting. This will prevent blisters and blemishes in vulcanization. Next comes the outer covering which—for convenience—we will call facing. This should be of a better quality than the center, as it is the point of contact when in use, and requires a better compound to give it more strength and longer life. This compound is mixed and milled and laid aside a few days to dry and harden before using. As soon as it is ready, warm up the batches on a warm mill and then feed it into the calender.

Again hang up the partially completed roll of packing and pass it once more between the calender rolls. The new strip or facing now spreads over the surface of the packing and completes the process. Care should be exercised again in regard to bubbles of air, as indeed should be the case whenever a new layer is applied to any roll.

The calender rolls should always be adjusted so as to make the sheet a trifle thicker than is required in the finished goods. This is to allow for shrinkage—and also for compression which the packing undergoes while confined between the plates of the hydraulic press.

Next we may take up the C. I. packing, which differs from the above in several ways. The sheeting used in this packing is frictioned on both sides, as the rubber is applied to both sides of the cloth. With this packing we have two facings, also, instead of one as in the above.

We now take this roll of sheeting and hang it up in front of the calender as before, then take the batches —those made from the trimmings—and warm them up on the mill as before, and when at the proper heat feed into the calender, at the same time the sheeting is passed into the rolls and the compound spreads over the surface of it. When one side of the sheeting has been covered, turn the roll around and run a coating on the other side. Continue this process until the desired number of piles is obtained. Thus the sheeting becomes embedded between the various layers of rubber. These layers are calendered sufficiently thin to permit of the two facings being still added to the outside and yet have the desired thickness when finished. All is now ready for the outside layers or facings, and these are applied to the roll as described in the case of C. O. S. packing, except that a facing is run on each side of the roll instead of one side as in the former case.

The third kind, or C. B. S. packing, is constructed in much the same manner as described, the exception being found in the facing, which, instead of being composed of rubber, has a layer of sheeting, frictioned on one side, applied to each side of the sheet of packing. The friction side of the sheeting, of course, goes next to the packing. This completes the construction or building-up process.

These three kinds of packing constitute the so-called cheap grades of sheet packing, and the vulcanization is the next process it undergoes. This description has been reserved until now, as the curing process is the same in case of all the three different kinds.

The roll of packing is now taken to the hydraulic press, but before this process begins the surfaces of the packing are dusted with powdered talc or soapstone, to prevent the plates of the press from sticking to it. is completed. The pressure of these polished plates

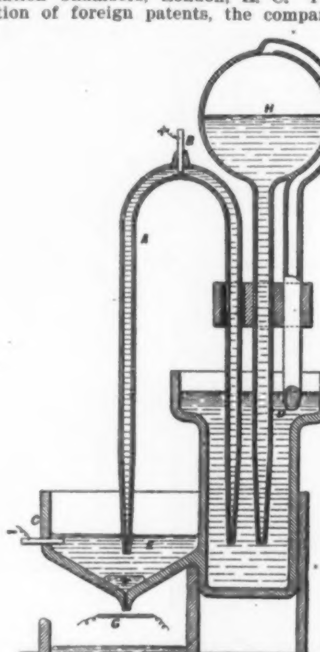
There is used generally for this purpose a belt press. This press is made in various lengths; but, for convenience, we shall select one of 25 feet. The upper plate of the press is made stationary by numerous supports or legs on either side, securely fastened into the floor or base of the press. The lower plate is made to move up and down between these two rows of supporters, so that when raised to the level of the upper plate the two plates will meet perfectly flush. The lower plate is raised and lowered by means of hydraulic pressure. These plates are several inches in thickness, and are hollow to permit steam to circulate evenly against the surfaces of the plates for the purpose of heating them.

In use, first heat the plates of the press to the temperature desired. The bottom plate is then lowered and the end of the packing pulled through to the opposite end of the press. Now turn on the hydraulic pressure, and the plate rises until the packing is firmly pressed against the upper one, where it remains until sufficiently cured.

This done, again lower the plate and pull through one more length of packing, and so on, until the roll is completed. The pressure of these polished plates gives to the packing a smooth surface while the heat is curing it. The roll should now be taken to a long zinc-covered table, where the rough edges are trimmed off with a sharp knife; giving the packing a neat appearance. One of the most important features in the manufacture of cheap packing is this curing process. The tendency is to over-cure, and this should be avoided; because cheap packing, being composed largely of shoddy, and in many instances semi-cured stock, will very naturally become hardened with little age. Therefore, it should have a soft cure to insure pliability and longer life.—The India Rubber World.

THE ARMORL ELECTRO-CAPILLARY RELAY.

THE daily press has recently contained notices of a system of wireless telegraphy which is now being developed by Messrs. J. Armstrong & Co., of Moorgate Station Chambers, London, E. C. Pending the completion of foreign patents, the company are not



THE ARMORL ELECTRO-CAPILLARY RELAY.

yet prepared to furnish full particulars of their system, and of the transmitter used; but we learn that the transmission is effected by earth currents. Two steel rods connected to the terminals of the transmitter are driven into the ground. Lines of flow of current proceed from one rod to the other, and these lines of flow extend, at least theoretically, to an indefinite distance. It is claimed that by employing suitable currents, and by using a sufficiently delicate receiver, these currents can be detected and used for telegraphy at a distance of some miles from the transmitting station. The company claim that with transmitter terminals at 10 feet apart, and the receiver terminals at a similar distance, telegraphy is easily effected over a distance of one mile; and with a greater space between the terminals, much greater distances can be covered. The relay for the receiving instrument is highly ingenious, and is illustrated diagrammatically in the annexed figure. In this *A* represents a siphon, of which the shorter leg dips into a reservoir of mercury, *D*, and its longer leg into a small tank of acidulated water, *E*. At the point where it enters this tank the bore of the siphon is so constricted that the capillary repulsion prevents the mercury flowing out under the head available. If, however, a current is passed through the mercury from *B* on to the tank, *E*, and out at *C*, the mercury, as in Lipmann's electroscope, tends to follow the current, and as a consequence droplets commence to flow out into the acid tank, and add themselves to the drop of mercury shown at *F*. This drop of mercury rests immediately over a small hole, as shown, this hole being in turn so small that the head of mercury above is just insufficient to produce flow. The addition of more mercury to the little mass above the hole upsets this equilibrium, however, and for every droplet adding itself to this mass from the siphon another droplet escapes from the hole below. In falling, this droplet closes the gap, *G*, in a relay circuit, and thus operates the relay. It will be seen that this electro-capillary relay, as it has been termed, is practically non-inductive, and its patentees are therefore sanguine that it will find applications to etherial telegraphy as well as to their own system. The arrangement shown at *H* is intended to preserve constant the level of mercury in *D*, and is, in fact, a modification of the well-known "chicken" water tank. If the level of water falls, air enters through the side tube shown, and allows a supply of mercury to flow into *D* from *H* until the opening to the side tube is again closed by the rise of the surface level.—Engineering.

COMPOSITE PHOTOGRAPHY.

WE have on several occasions given reproductions of photographs in which the same subject was represented in different attitudes and of different sizes. In most cases such effects are obtained by the use of a black background. Under such conditions, the operation is very easy, since the black ground has little or no effect upon the sensitized plate, and the subject can therefore occupy different places in succession provided the objective be closed after each exposure while he is changing his position. Very curious effects may be obtained in this way, especially if we change the scale of the subject and represent him, for example, holding upon his hand his own person reduced to the dimensions of a statuette. But it has been found that the use of the black background is quite monotonous and does not permit of giving the picture thus presented the aspect of truth that is desirable. There is, however, another method that has been employed for a long time and which has already been used for composite photographs, and that is the arrangement employed for taking vignettes. For this kind of photograph we place in the interior of the camera, between the objective and the ground glass, a sheet of cardboard provided with an aperture so as to prevent the action of the light upon the sensitized plate all around the bust. For composite photography, we can use, instead of the cardboard, a simple, rectangular sheet of paper that occupies but one side of the camera and marks about one-half of the sensitized plate. As this screen is somewhat distant (1.5 or 2 inches), it does not give a well defined line of demarkation, but a vignette that coalesces with the one produced by the second exposure. The effect produced may be ascertained by examining the image upon the ground glass. When it is a question of having a person pose twice, on each side of a table, for example, we think that this is the simplest method to employ. But when it is desired to increase the number of poses and complicate the picture, like the one shown in the engraving, in which the same person has posed four times, it is better to place the screen on the exterior. In fact, we must be able to select upon the ground glass the places to be protected, and if the screens are in the interior, this is not possible. We therefore arrange in front of the camera a bracket that projects about 6 or 8 inches from it. Such a result may be very simply obtained by placing the apparatus upon a sheet of cardboard projecting the above named number of inches on the objective side.

We then take two blocks of wood 0.8 of an inch in width and 2 inches in length, and, with a saw, make an incision therein for the reception of the sheet of cardboard. This latter is to be cut of the dimensions desired and interposed between the subject to be photographed and the objective. Spaces will thus be reserved upon the sensitized plate, at the time of the first exposure, in as large a number as may be desired, and at such places as may be selected. It will suffice to register upon the ground glass the spaces thus reserved in order afterward to fit the model

COMPOSITE PHOTOGRAPH. THE SAME PERSON TAKEN FOUR TIMES UPON THE SAME PLATE WITHOUT A BLACK BACKGROUND.

therein. It was in this way that the photograph reproduced herewith was obtained. The foreground to the right was first taken by masking the entire left part with a screen. The middle of the plate had not as yet been acted upon. In order to utilize this in two other exposures, the extreme right hand portion, already exposed, was masked with two screens, and then, upon a wider space, the left hand portion was masked in such a way as to include the part exposed and a little of that not yet exposed. There was then obtained in the third exposure the person placed in the background to the right, and the operation was repeated in an opposite direction for the fourth exposure. There need be no fear that the points of junction will be too visible, since the edges of the screens give a penumbra that blends very well with that produced at the same places in the following exposures. A little touching up of the negative will, if need be, permit of effacing every trace of the junctions.—For the above particulars and the engraving we are indebted to La Nature.

THE NOBEL PRIZES.

ALFRED NOBEL, the learned Swede, not only had the glory of associating his name with several important discoveries of the nineteenth century, such as

M. HENRY DUNANT.

PROF. VAN T'HOFF.

M. SULLY PRUDHOMME.

nitroglycerine, dynamite, smokeless powder, steel bronze, etc., but gained a large fortune in the industrial application thereof. Having been a lucky inventor, he thought that this too rare privilege had been the means of creating a debt that was due from him to society, and, in order to discharge this, he left at his death a will in which is exhibited the most intelligent and broadest conception of philanthropy.

As well known, one of the legacies directs the institution of five prizes of 150,000 crowns each (about $41,600) to be awarded to the most notable innovations in physics, chemistry and medicine, to the writer who should have produced the most remarkable literary work in the way of idealism, and to the man who should have contributed most toward bringing about fraternity and peace among the nations. The generous donor, moreover, expressed the formal wish that in the distribution no account should be taken of nationality, so that the reward should go to the most worthy.

These prizes have just been decreed by the Swedish and the Norwegian Storthing Academies united in plenary assembly for the formal ratification of the

PROF. ROENTGEN.

M. FREDERIC PASSY.

PROF. BEHRING

conclusions of the report of the commission appointed to examine the claims of the candidates.

The laureates are six in number: MM. Roentgen (physics), Van t'Hoff (chemistry), Behring (medicine), Sully Prudhomme (literature), and Frederic Passy and Henry Dunant, between whom were divided, *ex æquo*, the peace prize. Prof. Roentgen has, for the last six years, been celebrated throughout the world for the discovery of the rays that bear his name and that are called also "X-rays." The curious property of that mysterious light, by means of which it is possible to photograph through opaque bodies, and what valuable auxiliaries radiography and radioscopy are to medicine and surgery in current practice, are well known.

Prof. Van t'Hoff was born at Rotterdam, Holland, in 1852, but since 1894 has been lecturing at the University of Berlin. This master of contemporaneous chemistry, whose conception consists essentially in considering compounds as so many molecular structures arising from the ordinary laws of mechanics and geometry, has been styled the "Dutch Berthelot."

Henricus Van t'Hoff began his scientific studies at Paris. At the age of sixteen he made his debut at the Wurtz laboratory, where he had as a fellow pupil the French chemist Lebel.

The twenty-fifth anniversary of his nomination as doctor of sciences at the University of Utrecht was celebrated at Rotterdam two years ago.

Dr. Behring is, after Robert Koch, the most illustrious of German bacteriologists. His name has been made well known by his discovery of antidiphtheritic serum. However, without disputing the part that he has taken therein, it is well to remark that he has availed himself of the prior labors of several French scientists, such as Doctors Richet, Hericourt, Roux and Yersin. These latter, nevertheless, give him due credit for his personal merits; and it is well to recall the fact that when the Institute of France decreed the grand prize of 100,000 francs to Roux, he consented to accept it only on condition that Behring should receive half of it.

France has reason to felicitate itself on its lot in the distribution of the Nobel prizes.

No one among the contemporary writers was worthier of being distinguished than the poet Sully Prudhomme. The translator of the *De rerum natura* of Lucretius and the author of *Destins, Vaines tendresses, Justice* and *Bonheur* is, in fact, one of the brightest and noblest intellects with which French literature is honored.

M. Prudhomme, a Parisian by birth, is sixty years of age. He has been an Academician for twenty-five years, and is commander of the Legion of Honor and a member of the Council of that order. He has never sought either glory or honor, but both have come to him naturally without making him vain. He is a sage. His life, devoted to study, to work and to doing good, has ever been replete with modesty and dignity. In the recluseness to which delicate health condemns him, he receives few friends, and the physical suffering that he endures with the courage of a stoic does not affect his serenity, and never drives from his lips his habitually sweet smile. In his hands, Nobel's posthumous liberality runs no risk of lying idle, for he has already aided young poets in their difficult debuts, as more than one will bear witness, and hereafter he will aid them still more.

The choice of such a laureate is a just homage rendered to French literary genius in all that is most elevated, pure and disinterested.

M. Frederic Passy, who likewise is a Parisian, has reached his eightieth year, and for half a century has not ceased, by word and pen, to devote himself to the diffusion of the most generous ideas. An economist, he belongs to the Academy of Moral and Political Sciences, and has been a deputy; but it is to his indefatigable propaganda in favor of the progress of humanitarianism that he owes the best part of his renown. He was founder of the International League of Peace and the Society of the Friends of Peace, and, although up to the present he has had but a glimpse of the "promised land," his bold campaigns, conducted with as much perseverance as conviction, have not remained without results. Aided by his adepts, he has indicated and staked out the route for future generations.

Alongside of the venerable apostle of peace, an equitable judgment has placed the man whose efforts have tended to lessen the horrors of war; we refer to M. Henry Dunant, a native of Geneva, and almost a Frenchman.

M. Dunant, in 1859, was a witness of the battle of Solferino and was struck by the inadequacy of the medical service. In 1862, in a little book entitled "Souvenirs de Solferino," he described the fearful spectacle that he had witnessed, and decided upon the formation of societies composed of volunteers for parrying the effects of the carelessness and negligence of the medical personnel of armies.

Under his inspiration, the Geneva Society of Public Utility that he had founded in 1863 organized an international committee for the relief of the wounded, to which most governments sent delegates, and of which all those who were known for their humanitarian ideas formed part. M. Dunant's ideas triumphed therein, and the formation of a relief committee in every country was decided upon, with sections made up of volunteer infirmary nurses who were to be distinguished by a white band with a red cross worn upon the arm.

It was in the wake of these decisions that assembled the international congress which decreed the law of neutrality and philanthropy and which was called the Convention of Geneva.—For the above particulars and the engravings, we are indebted to L'Illustration.

ALFRED NOBEL: HIS LIFE AND WILL.

THERE will be accomplished in the month of December one of the strangest paradoxes that has ever occurred in the history of human nature. During his lifetime Mr. Alfred Nobel spent his whole career in intensifying the greatest instrument for destruction that has as yet been produced, and the wealth, which he had amassed as a result of his scientific experiments, he left by will in a worthy effort to promote the peace of the world.

The men who come after him and are to be part inheritors in his savings are forbidden to follow after the same pursuits in which Mr. Nobel engaged, but are to vie with one another to determine the surest means so as to make international warfare an anachronism and to guide the minds of men into the path of scientific research and of other peaceful attainments. This desire of Alfred Nobel is worthy of such a name, and, if we take a somewhat different view of the testator's eccentric action, we may fairly argue that his purpose, as set out in this testamentary document is not so diametrically opposed to the course that he adopted during his lifetime. He recognized that men still lived in a semi-barbaric age, that peace conferences were regarded with contempt, that the uncertainties of success alone prevented nations from flying at each other's throats or from taking aggressive liberties which the unsheathed sword alone could check. It came to this: if men must have war, let it be of such a nature that it would prove so destructive and so sharp and so horrible that the whole world would revolt against the repetition of the ghastly crime, and would with a unanimous acquiescence refer all disputes to a tribunal of peace.

Mr. Nobel could have put forward this argument quite fairly without in any way compromising his conscience as he busily applied himself to the day of his death in converting nitro-glycerine into a force of annihilation. It was not an easy task, and in view of the Nobel Institution to which we shall refer later, a brief study of his early career will show him to have been a man of splendid perseverance to the end, who overrode all difficulties that beset him.

He came of a family who were noted for their steadfastness, and who faced adversity with a fortitude that provoked success. In the first years of the last century his father was born. Emmanuel Nobel commenced life as an architect and obtained a government appointment in the architectural office. Like all officials he looked for a pension rather than wealth from such an appointment, but he made the most of his leisure moments in devising ideas of a more or less practical nature. On one occasion he put so much faith into a little invention that he had contrived, that he left his post in 1843 and traveled to St. Petersburg, hoping to make a fortune. He was a bold man to have journeyed so far without having put his idea to the test, and either he had too much confidence in the invention or else he was ignorant of the prejudices of government officials, who in every country balk the enterprise of a civilian whenever he tries to give to them advantage over other nations.

Fortunately, Mr. Nobel was rewarded for his courage, for he was employed to lay subterranean mines conical in shape which contained a mixture of ordinary tin, black powder, chlorate of potash, and sulphuric acid in a box surrounding a glass tube which held sugar crystals.

For this task he received the handsome sum of a hundred thousand rubles, but it passed through his hands as quickly as the grains of powder which he daily sampled. In a short while he became so embarrassed that he actually had to pawn the watch which the Tsar had presented to him in recognition of his work.

It was not long before the Russian government again required his services. The Crimean war had commenced. The Ministers were in a state bordering upon panic, for those responsible at the War Office were found to have been negligent in their duties and to have casually overlooked in the hour of peace to lay down any mines in the harbors. One man alone could save them, but he had reached an age when he was content to delegate his duties to his son Robert, who was then not more than twenty-five years of age.

Robert Nobel possessed the sanguine temperament of his father, and, without hesitation, replied, "I can manage these defenses for you, but you must give to me a ship." This was immediately granted to him, and, although he had never been in the navy or any other service, he was at once promoted to the rank of an Admiral of the Fleet, an honor which could have been considered not too high a merit, since he saved Kronstadt from attack and capture, and almost succeeded in effecting a greater distinction, the successful accomplishment of which would have given to the British public an instant cause to mourn.

He laid down about a hundred small submarine cables, and left free no more than a strait for the passage of ships which had to make for a refuge in the harbor. These preparations had scarcely been completed when a British man-of-war hove in sight, riding straight to her doom. Before her, in the same line and quite contrary to the strictest injunctions, danced a small Finnish ship which paid a heavy penalty for its disregard of orders, for it was blown up within the sight of the "Duke of Wellington," and so enabled the English commander to steer away clear of the impending danger. He did not, however, leave the harbor before he had made an effort to net the cables, but the crew that was sent out to carry out the orders suffered another explosion which resulted in the loss of one life. This was danger enough for the commander, who saw little chance of forcing a way into the harbor. The "Duke of Wellington" put out to sea, and Kronstadt was never again disturbed during the campaign by the too near approach of unfriendly warships. This was an undoubted advantage to Russia, as her generals were able to concentrate their troops in that city of the dead, Sevastopol.

Some five years after peace had ensued between the different contesting countries in Europe, Emmanuel Nobel returned with his four sons to his own native land. Fortune, as estimated in shekels, seemed as far distant from the family on the day of their return as when they had left the shores of Sweden. Robert, the eldest son, worked with his father; Ludwig, the next brother, remained behind, as he had been appointed as inspector of arms in Russia. In later life he was known to have the same generous disposition as Alfred, but he never attained to the same wealth which fell to the lot of Robert, who eventually went to the Caspian Sea and discovered the petroleum springs of Baku. This member of the family commenced by carrying the oil away from the springs in wooden casks, as he had not enough capital to make an outlay on tin canisters; but Alfred was by that date in a wealthy position. He gave assistance to his elder brother, and invested over ten million rubles in the concern, in return for which he claimed half the profits.

At the time, however, to which we are at this moment alluding, the idea of reaching to the position of a plutocrat would have been a fancy dream; for while his third brother, Emil, was struggling as a student at the University, he was quite content to be a partner with his father in a milk shop. Mr. Nobel, senior, in spite of his pacific occupation, still pursued his old hobbies; and, when a Swedish committee had been appointed to inquire into the best method for placing submarine mines in the harbors, Emmanuel Nobel saw his opportunity. He worked out an elaborate scheme of his own, confident that it would receive some practical recognition, but he was completely crestfallen when he heard nothing whatever from the experts.

It is quite possible that jealousy or prejudice checked the recommendation that he otherwise deserved. He must have been known to the committee, for, as far back as 1848, during a residence in France, he had produced the first nitro-glycerine powder that was then known. His discovery did not pass unchallenged, for there was an Italian claimant, and in 1896 a scheme was devised for erecting a statue to "the Italian Subrero, the Columbus, and Alfred Nobel, the American Vespucio."

Similar disputes did not arise in regard to later inventions. In 1862 Alfred Nobel took the position that his father had held, and discovered how to make an explosion by means of a flame, and this was the protoplasm of his most successful contribution to science. Like his father, he had to encounter various difficulties, and the small factory which he had erected in Sweden existed no longer than two years before it was blown up. The incident was a pathetic one, for it sealed the fate of Emmanuel, who shared the lot of those who perished in the explosion. Prof. Cronquist, who has now attained to the highest post in connection with the inspection of explosives in Sweden, had a miraculous escape. Within two hours previous to the accident the elder Nobel had declined to accept his proffered services on the ground that the partnership of two sons was quite sufficient to direct the business.

The disaster so alarmed the public that Alfred Nobel, who at once stepped into his father's place, was unable to obtain a lease on any land for the erection of a manufactory. He was in despair when the thought occurred to him to purchase a coal barge. This scheme, however, was more happy in the conception than in its actual accomplishment, for he had the greatest difficulty in procuring a proper anchorage. To add to the risk of his adventure he found himself in financial straits, but a M. Yvers Smitt so admired his persistency that he was willing to advance to him the necessary funds for proceeding. Alfred Nobel was well content, he valued his monopoly at a proper price, and set out for Paris in the following year (1866). The disposal of patents to foreign companies was an idea that was little contemplated in those days, but Alfred prosecuted his intentions and launched a French company of ten million francs, the first of ten companies which he meant to form in as many different countries. As a return for his venture he was appointed managing director, and, within a short while after, a second factory was set up in a small Belgian village. Others, also on somewhat similar lines, were established eventually, both in Sweden and in Hamburg.

It was in this last that he discovered by chance dynamite Guhr. Some of his powder had trickled out of a cask onto the damp soil and become spoilt with the infusorial earth. This was a happy accident, for, as soon as the moisture had evaporated, he found that one part of this earth to three parts of nitro-glycerine not only improved its substance as an explosive, but made it safer for handling.

From this moment the business began to prosper beyond all previous contemplation. Three companies were started in America, while a fourth was run in California, near Oakland, where only Chinese were employed. This economy in labor proved a disastrous expense, for there occurred an explosion so terrible that its impact was felt at a distance of forty miles. Ultimately there were as many as three factories in France, two in Belgium, and one in Sweden, with all of which Alfred Nobel was directly connected.

In England, on the other hand, he met with no success, a fact which has been attributed to our insular prejudice against embarking on any enterprise that was in any way due to foreign initiative. It was believed by many that there was an even stronger contributory cause in the person of Sir Frederick Abel, who desired to have no rival in the field of explosives. In Scotland there was not apparently the same objection to the introduction of the Nobel powder, for, just thirty years ago, the inventor started a factory at Ardrossan near Glasgow, over which he set his brother Robert as manager. Since that date he has been succeeded by M. Lundholm, who was at that time acting under him as sub-manager. This factory is now the largest in the world of its kind, and has produced no less than one million seven hundred thousand pounds worth of capital. In 1879 Alfred Nobel dissolved nitro-cellulose in nitro-glycerine, which gave it a more gelatinous substance. After this he found that the more gelatinous cellulose was mixed in the nitro-glycerine the more solid it became, and the more slowly it burned, both of which were important discoveries. Of this substance he made a fuse, only to find that it was hardly satisfactory because it had not sufficient strength to act as a driving force.

The upshot of this was the advance in ballistite made from soluble nitro-glycerine, and in 1889 he gave up his right to England. Then arose the contest between cordite and ballistite. A committee was appointed, ballistite was declared to be of no account, and cordite, which was the same as the other material save that it was composed of non-soluble nitro-cellulose and nitro-glycerine, won the day. Alfred Nobel was the more sensitive to this defeat because the inventor of cordite happened to be one of the members of the committee constituted to judge between the respective merits of the explosives. He considered that there was no material difference though his patent had been made from soluble substance only. However, the English government qualified the severity of their verdict by promising to purchase all the ballistite that the Scotch factory produced, so that the home at Ardrossan has reaped a considerable benefit therefrom.

We mentioned that the manager of this particular factory is a Swede; Alfred Nobel always chose his own countrymen for these responsible posts. Some might be disposed to regard this presumptive partiality as evidence that Nobel was a greater patriot than a fair man of business with a due regard for his employés' interests. There are no grounds whatever for such suspicions, for, just as a German student devotes his chief attention to bacteriology, or an English chemist to mineralogy, so will a Swede make the science of explosives his primary study. Undoubtedly the success of their countrymen makes them ambitious in this particular direction, or perhaps they, like him, wish to hasten the termination of the trial of ordeal by war. On the other hand, it shows what a potent influence the career of Alfred Nobel has had upon the residents of Stockholm.

We now await the passing of time to prove whether or not the efforts of Alfred Nobel have avoided becoming a laudable failure. We have previously stated that the clauses in his will are no real irony upon his action during his lifetime. Like a surgeon of daring, he sought to excise the cancer of war by using the most dangerous instruments, since none other could be effectual.

Men, too, readily bought his death-dealing explosives; their only thought was to hold their own supremacy by the slaughter of their enemies. They wasted millions of money in this way, and Alfred Nobel hoarded it up as a rebuke to their distrust of each other and to establish the fact of Milton's most powerful line that "Peace hath her victories no less than war." At this moment professors, experts, and public officials in different countries are puzzling their minds how they can most equitably apportion the interest that has arisen from his bequest.

Five years ago Alfred Nobel died at the age of sixty-four and a bachelor, without any responsibilities save the remembrance of a few friends and one or two of his nephews to whom he left legacies of some £5,000 each. One or two of his relatives were omitted, and they have decided to go to law on the matter, not because there is any dispute to deprive them of the same claim by which the more favored nephews are gainers, but rather *pro forma*. It was arranged that the will was not quite clear, so that an appeal might be made to the court to obtain an exact definition. These, however, are petty items when the whole of the will is taken into account, and the sum of thirty-five million kroners or about two million pounds has been definitely set aside for investment to provide the interest of £60,000 which is to be divided quinquennially among the five different persons who have been adjudged to have most advanced the cause of peace in some particular department.

The terms upon which every candidate must qualify are extremely original and will bear a close study. In spite of his Swedish proclivities Nobel was so ready to recognize the merit of other countries that he directed that the Norwegian Storthing or Parliament should adjudicate in the selection of the individual who appeared by his own efforts to have most advanced the cause of peace. This difficult honor was bestowed upon the Parliament assembled at Christiania, because it was the first official body to attempt to organize an International Peace Union. The celebrated playwright, Bjornsterne, has been one of those deputed to settle this difficult award. This has been at some personal sacrifice to himself, because he is debarred at once from being one of the candidates for the coveted honor. He is well known as an ardent seeker of peace, though he is bellicose enough in his speeches and spares neither king nor peasant with his tongue; but it is highly interesting to learn that M. Jean de Bloch made a strenuous effort to induce the Tsar to nominate the Norwegian.

It would be not a little curious if, notwithstanding the aspirations and hopes of more prominent speakers, the committee were to convey the award to a missionary as having the most direct claim. These men, however, are a class distinct from the rest of men, and as they have become accustomed to the spiteful accusations of having indirectly hastened nations into war, they will probably have to stand aside in favor of one who has used his silver eloquence in the course of his ordinary civil life. If the committee so decide, this prize can be kept back, so that the interest can accumulate for rewards in later years. Further, the honor can rest with a society no less than with an individual, but in either case a foreign person or association has to recommend the candidates. The fighting Parliament of Hungary has thought it fit to propose the Bureau in Berne as most worthy to be the recipient. Among the individual names we naturally expect to find that of Tolstoi. We have already mentioned the honor that would have been conferred on Bjornsterne had he not himself formed one of the committee. M. Gobart, the Austrian author, and M. Suttner, who published the work entitled "Down With Weapons," are also inscribed upon the list. Possibly more than one of these may share in the prize, which can be split up into two parts.

Furthermore, most of them would have a chance of winning the second bequest, which is to be awarded for the best literary thesis in favor of peace. These written contributions will be decided by the Swedish Academy at Stockholm. The author is restricted to no particular language, so that a Buddha scribe may come from the East. The judges are quite expectant that it will prove a costly task, but provision has been made for an outlay not exceeding 25 per cent of the prize to be spent in establishing a Nobilianum or library, in which will be collected any book that may assist the judges to secure a ready reference to such works as the aspiring essayists may allude, and to assist them more especially in the translation of such compositions that may happen to be written in a special language. Strange to say, exceptional provision will be made to possess suitable glossaries in Russian, yet no other nations in Europe cause so much unrest to their neighbors as do the inhabitants of this territory. Translators can be engaged if it is found necessary, but their intrusion is likely to mar the success of the candidate if any account is taken of style. On the other hand, while the expression of thought may possess a charm of its own, the judges (all of whom, in this instance, must be Swedish) would be exceeding their proper province of criticism if they gave credit for the style rather than the matter contained in the plea for peace. For this reason the force of an argument can be more efficiently tested, if it is equally cogent, in a language other than that in which it was written.

Whatever be the result of this contest for the bay crown of Peace there is almost certain to arise some difference of opinion, for, when the time for selection is ripe, nations will acclaim the merits of their own countrymen, however much they may have ignored them in the past, and they will set the weight of their feeling against the verdict of a few experts. This would be but human. On the other hand, we fail to see what better system could have been devised, for the utmost care has been taken to appoint competent judges. Chief of them sits no less a personage than the Professor of Literature at Gothenburg, who receives 6,000 kroners a year, a sum not too great

considering the responsibilities that devolve upon him. Moreover, he will have no light task if it falls to his lot to select the books to be placed on the shelves of the Nobel Pantheon.

There is less interest in the other three awards as regards presenting an explanation of their purpose. They will be devoted to some special branch in science. It may be said that, while the judges in the first two instances choose a candidate who has done his best to proclaim the virtues of mercy and amity from the house-tops, in the last three instances the prizes will go to those who have retired to and labored the most industriously in their secluded laboratories. Eighteen members from the Svenska Academy of Science at Stockholm will be called upon to nominate the doyens in physics, in medicine, and in chemistry.

Prof. Koch might win the purse of honor if he could only satisfactorily prove his recent attack against animal tuberculosis, but there might be some who would be disposed to say that he had only secured a negative triumph in that so far from benefiting the world as a new Æsculapius, he had only succeeded in banishing an erroneous supposition.

Every candidate who competed in the hope that some new invention of his would achieve his ambition, would be called upon to take his patent to Stockholm for inspection, but in the event of another's boast being more triumphant, he would be allowed his traveling expenses.

It can be well understood that a considerable amount of attention must have been given to investing Alfred Nobel's vast wealth, for others before and after him have had larger fortunes, and died in comparative penury. Many, however, will be astonished to learn that the inventor left the care of his money to a single lady resident at Stockholm, who thus proved by her ability that ladies can occasionally become good financiers, though we do not on that account advise a nation to entrust to them the public exchequer.

M. Nobel's executor is M. Sohlman, who has never acquired any previous knowledge of bookkeeping, and who is still some years short of thirty. But he attained the special confidence of M. Nobel, because "he is a man who has never asked anything of me." This last remark might be misconstrued, for the millionaire was no miser, though none could guess what he spent on charities, for all his gifts were made without ostentation and with as much secrecy as possible. This generosity extended to his own workmen, whose numbers were not less than a hundred thousand. None of them went on strike in spite of their numerical strength, because he insisted on paying them well, so he secured among them the *sobriquet* of "Nobel by name, and noble in deed."

Quite apart from his inexperience M. Sohlman had the additional difficulty of being engaged on military service at the time when he was called upon to carry out his executive duties. It was, therefore, a relief to him to feel that he had as his colleague the manager of the factory at Bergen, who was to receive a sum of £500, but even he found it more profitable to hand over his responsibilities to a lawyer, M. Santeson, of Stockholm. Their duties, however, will be less arduous than they might have been, for, distinct from the complications that will arise in connection with the various legacies, instructions have been given to executors to invest the whole of the two million pounds in government stocks, which will undoubtedly prove an admitted benefit to the country, but it will also once and for all dissociate the name of Alfred Nobel from the business which he formed, at least in so far as finance is concerned. Others, however, will willingly accept the securities and the responsibilities, for the firm has become so sound that it is not likely to fail from want of capital. Indeed, its end can only result when an international peace has been established, and the fruit of Alfred Nobel's final efforts shall have become an established fact.—A. EDMUND SPENDER. Reprinted from The Westminster Review by permission of the Leonard Scott Publication Company.

SUPPLEMENTARY REPORT OF PANAMA CANAL COMMISSION IN FAVOR OF PANAMA.

It will remembered that the Isthmian Canal Commission in its report recommended the Nicaragua route on the ground that it could come to no satisfactory arrangement with the owners of the Panama property. Since the report was made the Panama Company have offered to sell to the United States for $40,000,000, the value set upon its property by the Commission. In a supplementary report the Commission now recommends unanimously the adoption of the Panama route.

The report of the Isthmian Canal Commission, recommending the purchase of the Panama Canal Company's rights, property, and unfinished work, is as follows:

The "totality, without exception, of its property and rights on the Isthmus," mentioned in the cablegram of January 9, includes the following classes of property:

1. Lands not Built on.—There are fifty-six parcels of land, to which the title rests in the canal company, amounting to about 30,000 acres, which with the lands belonging to the railroad company cover nearly all of the ground required for the actual construction of the canal.

2. Buildings.—There are scheduled 2,431 buildings, divided among forty-seven subclassifications, used for offices, quarters, storehouses, hospitals, shops, stables, and miscellaneous purposes. Among them are two large permanent buildings in Panama, one used as the headquarters residence, and the other as the general office; large general hospitals at Colon and Panama, and several important buildings at Colon. These buildings are furnished.

3. Plant.—There is an immense amount of machinery consisting of floating plant (tugs, launches, dredges, etc.).

4. Work Done.—The excavation already accomplished upon the main canal line, which will be of value in the plan recommended by the Commission, was carefully computed and was found to be 36,689,965 cubic yards. A temporary diversion of the Panama Railroad has been made at the Culebra cut, which also must be considered. Using the same classification of materials and the same unit prices as in the other estimates, with the 20 per cent added for contingencies, the value of the work done is found to be:

Canal excavation	$21,020,386
Chagres diversion	178,186
Gatun diversion	1,396,456
Railroad diversion (four miles)	300,000
Total	$22,895,028
Contingencies, 20 per cent	4,579,005
Aggregate	$27,474,033

5. Panama Railroad.—Of the existing 75,000 shares of the Panama Railroad, the canal company will transfer to the United States all but about 1,100 shares. These latter are held by a few individuals residing in various parts of the United States and in Europe. At par the value of the 68,863 shares to be transferred to the United States by the canal company is $6,886,300.

CLAIMS AGAINST THE COMPANY.

Against this property are mortgage bonds to the amount of $3,439,000. Of this amount the company owns $871,000, which it has pledged as collateral for its debt to the Panama Canal Company described below, and it also holds in its treasury $1,064,000 subject to sale or cancellation, leaving outstanding in the hands of the public $1,504,000. The bonds bear 4½ per cent interest.

There are outstanding also $996,000 6 per cent sinking fund subsidy bonds, but this liability is an amortization of the annual payment of $225,000 due the Colombian government under its concession for the period ending November 1, 1910.

The railroad company owes $986,918 to the Panama Canal Company, mainly on account of the construction of the pier at La Boca.

Its total liabilities therefore are $2,490,918, not counting the sinking fund subsidy bonds, for which the Colombian government has received the benefit, and for which it should make allowance to the United States in the negotiations for treaty rights.

Its cash assets January 15, 1902, were $438,569. It owns three passenger and freight steamers of American registry, of approximately 2,000 tons net each. For the past year it has operated a line of chartered steamers of American registry between San Francisco and Panama. These steamers on the Atlantic and Pacific constitute the Panama Railroad Steamship Line.

The railroad company owns an undivided half interest in the islands of Naos, Culebra, Perico, and Flamenco in the Bay of Panama, the Pacific Mail Steamship Company being the joint owner.

Besides the right of way, terminals, wharves, and considerable areas of land, it owns nearly the whole of the town of Colon, the houses there being constructed under leases. The railroad company has no operating contracts which cannot be terminated in ninety days. The work of constructing the canal will largely increase the business of the railroad, and will enable it to pay off its liabilities in a very few years. After the completion of the canal its commercial profits will probably cease, but it will have a value incidental to operating the canal.

6. Maps, Drawings, and Records.—The value of the maps, drawings, and records in Paris, on the Isthmus, or elsewhere, all of which are to be transferred to the United States, is placed at $2,000,000.

Summing up the foregoing items, the total value of the property is found to be:

Excavation done	$27,474,033
Panama Railroad stock at par	6,886,300
Maps, drawings, and records	2,000,000
Total	$36,360,333
To which add 10 per cent to cover omissions, etc.	3,639,667
Total	$40,000,000

The last item is intended to cover any buildings, machinery, railroad shares, additional excavation to date of purchase, and other assets which may be of value to the United States, and have not been included in the other items.

ADVANTAGES OF THE PANAMA ROUTE.

The estimated cost of constructing the Nicaraguan Canal is $45,630,704 more than the cost of completing the Panama Canal. The estimated annual cost of maintenance and operation is $1,300,000 greater at Nicaragua than at Panama.

The Panama route would be 134.6 miles shorter than the Nicaragua route from sea to sea, with fewer locks, and less curvature, both in degrees and miles. The estimated time for a deep-draught vessel to pass through the Nicaragua Canal was placed at thirty-three hours, as against twelve hours for Panama, these estimates being the time of actual navigation, and not including delays for winds, currents or darkness.

If the passage were made without interruption about a day could be saved by the Nicaragua over the Panama route by ordinary steamers handling commerce between our Pacific ports and all Atlantic ports, and about two days by steamers of the same class trading between our Gulf ports and North Pacific ports. The time of the Nicaragua route would be less in the case of fast, high-powered steamers, the use of which is increasing. Between Atlantic ports and the west coast of South America the Panama route has the advantage of about two days, and between Gulf ports and the west coast of South America the Panama route has the advantage of about one day. The trade of the western coast of South America is a very important one, which has hitherto been in European hands.

The Panama route is an old highway of commerce along which no considerable industrial development is likely to occur. During the construction of a canal on the Nicaragua route business relations would be established with Costa Rica and Nicaragua which would be likely to continue. Existing conditions indicate hygienic advantages at Nicaragua, though equally effective sanitary measures must be taken in both cases.

The offer received from the new Panama Canal Company to convey all its property, including all its interest in the Panama Railroad, to the United States will make the estimated cost of the two canals as follows:

Nicaragua	$180,864,062
Panama	184,233,358

The transfer would give title to all the land now held by both the Panama Canal Company and the Panama Railroad Company, which covers nearly all lands required for the construction of the canal. This land, held by private parties at Nicaragua, must be acquired, and its acquisition may prove expensive.

The question whether the new Panama Canal Company can make to a purchaser a valid title to the property formerly belonging to the old company, its predecessor, has been considered and answered in the former reports of the Commission, but in view of its importance, in connection with the present offer, the results of the investigations made will be again presented.

The old company, in addition to its canal property acquired under a concession from the Colombian government, owns nearly all of the shares of the Panama Railroad Company. By purchasing these it obtained the control of the concessions under which the road had been built. The latter concessions will continue in force until 1966; the canal concession is to run for 99 years from the day on which the canal shall be opened to public service, and the date for this in the concession, according to its latest extension is October 31, 1910. When these periods expire the different properties are to belong absolutely to Colombia without compensation, and the government is under no obligation to extend either concession.

The canal company is absolutely prohibited to cede or mortgage its rights under any consideration whatever to any nation or foreign government under penalty of forfeiture. The contract with the railroad company contains a like prohibition, and declares further that the pain of forfeiture will be incurred by the mere act of attempting to cede or transfer its privilege to a foreign government, and such an act is declared absolutely null and of no value or effect.

CONDITIONS OF THE PURCHASE.

But for the purpose of permitting the new Panama Canal Company to enter upon the negotiations which have resulted in the present offer, Colombia has waived these prohibitions and has authorized the company to treat directly with the United States, with a view to the use and occupation of the territory of the former for canal purposes if our government should select the Panama route for an Isthmian canal. After the old company failed, a liquidator was appointed by the French court to take charge of its property and affairs. When the new company was formed he was authorized to contribute to it the rights, privileges, plans, documents, plant and unfinished work in his hands and under his control, and in consideration of this grant he was to receive 60 per cent of the net profits of the enterprise after deducting all expenses, charges, and stipulated dividends, to be distributed by him among the parties in interest.

This interest of the old company is still under the protection of the liquidator, and he must be a party to any arrangement that may be entered into for a sale of the property, and as he derives his authority from the tribunal that appointed him his action requires the approval and confirmation of the court. The papers before the Commission show that the liquidator has agreed to the proposition, and that he is acting under judicial authority.

A deed to the property executed by the canal company and the liquidator requires the approval of the government of Colombia because of the prohibition already referred to in the concessions and for the further reason that the republic owns 50,000 shares of 100 francs each of the stock of the company, full paid, of which it cannot be deprived without its consent. Such a transfer of title thus approved would give to the United States the same right, title, and interest in the premises that the new Panama Canal Company now has, but that would not be sufficient. The existing concessions thus purchased would be valuable only because their ownership by the United States would remove the obstacles in the way of negotiations between the two governments for the occupation of Colombian territory by the United States for canal purposes, but these concessions are unsatisfactory and insufficient and a new arrangement must be made if an Isthmian canal is to be constructed by our government across the Isthmus of Panama.

ABSOLUTE OWNERSHIP DEMANDED.

The grant must be, not for a term of years, but in perpetuity, and a strip of territory from ocean to ocean of sufficient width must be placed under the control of the United States. In this strip the United States must have the right to enforce police regulations, preserve order, protect property rights, and exercise such other powers as are appropriate and necessary. The business relations between the railroad and canal companies and the Colombian government must also be settled, and the consideration to be paid by the United States for the privileges and rights to be exercised in the future must be agreed upon free from all embarrassment with reference to past transactions.

The Commission has no power to enter upon negotiations for the arrangement of these matters; they belong to the treaty-making power; but the acceptance of the terms offered by the new Panama Canal Company should be conditioned upon their satisfactory adjustment.

The advantages of the two canal routes have been restated according to the findings of the former report. There has been no change in the views of the Commission with reference to any of these conclusions then reached; but the new proposition submitted by the new Panama Canal Company makes a reduction of nearly $70,000,000 in the cost of a canal across

the Isthmus of Panama, according to the estimates contained in the former report.

There is, however, one important matter which cannot enter into its determination, but which may in the end control the action of the United States. Reference is made to the disposition of the government whose territory is necessary for the construction and operation of an Isthmian canal. It must be assumed by the Commission that Colombia will exercise the same fairness and liberality if the Panama route is determined upon that have been expected of Nicaragua and Costa Rica should the Nicaragua route be preferred. The report concludes as follows:

After considering the changed conditions that now exist and all the facts and circumstances upon which its present judgment must be based, the Commission is of the opinion that "the most practicable and feasible route" for an Isthmian canal, to be "under the control, management, and ownership of the United States," is that known as the Panama route.

The report is signed by the entire Commission, as follows: J. G. Walker, Rear-Admiral United States navy, President of the Commission; Samuel Pasco, Alfred Noble, George S. Morison, Peter C. Hains, Colonel United States Corps of Engineers; William H. Burr, O. H. Ernst, Lieutenant-Colonel United States Corps of Engineers; Lewis M. Haupt, and Emory R. Johnson.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Goods in Smyrna.—An earnest effort has recently been made by the representative of a New York firm of export merchants to introduce American goods into Turkey, and this effort has met with considerable success. The representative referred to visited Constantinople with his samples. He remained two or three months and disposed of something like $40,000 worth of American goods. He then came to Smyrna with his samples and rented a room. He displayed to the merchants certain lines of cotton goods consisting of cabots, drills, calicoes, prints, sheetings, etc.; hardware, tools, files, bits, common shears, locks, knobs, razors, knives, padlocks; leather, lambskins, goatskins, toys, etc. He made arrangements with Avedikian Freres, of Smyrna, to handle his goods, and through them sold from sample some $25,000 worth of American merchandise. The representative remained here but four weeks, but in that time he paved the way for extensive future business, and was the means of introducing many new lines of American goods. I learn from him that the chief obstacle in the way of developing American trade is German competition. He declares that in many instances the Germans, to gain business, dispose of large quantities of goods at absolutely cost prices, and give long credits. More than this, they make articles which are especially adapted to this market. Their goods have an attractive appearance, but are of inferior construction and quality.

I learn further that Americans seem to be unable to meet English competition in cotton prints (an article of great importance in this country). The English goods are cheaper and conform to the requirements of this market. Local merchants say that cotton prints should be about 28 inches in width, the cheaper qualities 26 to 27 inches, and the better qualities 28 to 29 inches. The designs should be devoid of figures of animals; those of men, women, horses, dogs, or birds being especially objectionable. Flowers and vines are desirable in bright, gaudy colors, especially red and yellow or blue and green. In case American manufacturers desire samples for the purpose of studying the designs, quality, colors, widths, etc., I shall be glad to forward them.—Rufus W. Lane, Consul at Smyrna.

Exhibition and Congress of Fisheries at St. Petersburg.—The International Congress of Fisheries and Fish Culture, at its last session in Paris in 1900, decided to hold the next session at St. Petersburg. The Imperial Russian Society of Fisheries and Fish Culture has received imperial sanction and has completed arrangements for an exhibition, to commence on January 28, 1902. The congress will open on the 22d of February, and both will close March 8.

The exhibition is open to Russians and foreigners. Among its objects are to determine the actual condition of sea and fresh water fisheries, and of other similar pursuits; to acquaint producers and consumers with the various products of fisheries, and with methods of preparing and preserving the same; to exhibit the gradual development and actual state of artificial fish breeding, as well as the various aspects of amateur fishing and angling; to promote scientific research in the interests of fisheries.

The congress will discuss questions pertaining to the present position and needs of fisheries and fish industries from scientific, economical, technical, industrial, and commercial points of view, and will also consider measures for the improvement of these branches of industry.—W. R. Holloway, Consul-General at St. Petersburg.

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